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TRANSACTIONS

OF THE

COLLEGE OF PHYSICIANS

OF

PHILADELPHIA

THIRD SERIES

VOLUME THE FIFTIETH

PHILADELPHIA
PRINTED FOR THE COLLEGE
1928

NOTICE

The present volume of TRANSACTIONS contains the papers read before the College from January, 1928, to December, 1928, inclusive.

The Committee of Publication thinks it proper to say that the College holds itself in no way responsible for the statements, reasonings, or opinions set forth in the various papers published in its TRANSACTIONS.

EDITED BY

WALTER G. ELMER, M.D.

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DORNAN, PRINTER

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LIST

OF THE

PRESIDENTS OF THE COLLEGE FROM THE TIME OF ITS INSTITUTION

ELECTED	
1787	JOHN REDMAN
1805	WILLIAM SHIPPEN
1809	ADAM KUHN
1818	THOMAS PARKE
1835	THOMAS C. JAMES*
1835	THOMAS T. HEWSON
1848	GEORGE B. WOOD
1879	W. S. W. RUSCHENBERGER
1883	ALFRED STILLÉ
1884	SAMUEL LEWIS†
1884	J. M. DA COSTA
1886	S. WEIR MITCHELL
1889	D. HAYES AGNEW
1892	S. WEIR MITCHELL
1895	J. M. DA COSTA
1898	JOHN ASHHURST, JR.
1900	W. W. KEEN
1902	HORATIO C. WOOD
1904	ARTHUR V. MEIGS
1907	JAMES TYSON
1910	GEORGE E. DE SCHWEINITZ
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1919	WILLIAM J. TAYLOR
1922	THOMAS R. NEILSON
1925	HOBART A. HARE
1928	JOHN H. GIBBON

* Died four months after his election.
† Resigned on account of ill-health.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

1928

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FELLOWS

OF THE

COLLEGE OF PHYSICIANS OF PHILADELPHIA

DECEMBER, 1928

* Non-resident Fellows. † Fellows who have commuted dues. ‡ Deceased.

ELECTED

1892. Abott, Alexander Crever, M.D., Sc.D., Dr. P.H., Professor of Hygiene and Bacteriology and Director of the School of Hygiene and Public Health, University of Pennsylvania. 4016 Pine St.

1912. Addison, William H. F., A.B., M.D., Professor of Normal Histology and Embryology in the University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1926. Adler, Francis Heed, M.A., M.D., Assistant Surgeon, Wills Eye Hospital; Instructor in Ophthalmology and Physiology, University of Pennsylvania. 313 S. Seventeenth St.

1905. Adler, Lewis H., Jr., M.D., Formerly Professor of Proctology in the Graduate School of Medicine, University of Pennsylvania; formerly Prosector to the Professor of Anatomy in the University of Pennsylvania; Consulting Surgeon to the Charity Hospital. 313 S. Seventeenth St.

1914. Aiken, Thomas Gerald, M.D., Physician-in-Chief to the Chester County Hospital, West Chester, Pa.; Pathologist to the Country Branch of the Rush Hospital for Tuberculosis. Berwyn, Pa.

1913. Alexander, Emory G., M.D., Assistant Professor of Surgery, Medical School, University of Pennsylvania; Surgeon to the Episcopal, St. Christopher's Hospital for Children and Abington Hospitals. 337 S. Eighteenth St.

1906. Allen, Francis Olcott, Jr., A.B., M.D. 2216 Walnut St.

1896. Allyn, Herman B., A.B., M.D., Visiting Physician to the Philadelphia General Hospital. 3910 Chestnut St.

1888. Anders, James M., M.D., LL.D., Professor of Medicine in the Graduate School of Medicine, University of Pennsylvania; Officer de l'Instruction Publique. 250 S. Seventeenth St.

ELECTED

1905. Anspach, Brooke M., M.D., Professor of Gynecology in the Jefferson Medical College; Attending Gynecologist, Jefferson Hospital; Attending Gynecologist to the Bryn Mawr Hospital. 1827 Spruce St.

1905. Appleman, Leighton F., M.D., Attending Surgeon to the Wills Eye Hospital; Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Ophthalmologist to the Frederick Douglass Memorial Hospital and to the Burd School; Demonstrator of Pharmacy and Materia Medica, and Instructor in Therapeutics in the Jefferson Medical College. 308 S. Sixteenth St.

1922. Arnett, John Hancock, A.B., M.D., Physician to the Episcopal Hospital; Instructor in Medicine, Medical School, University of Pennsylvania. 2116 Pine St.

1906. Ashhurst, Astley Paston Cooper, A.B., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the Episcopal Hospital and to the Philadelphia Orthopædic Hospital and Infirmary for Nervous Diseases. 257 S. Sixteenth St.

1893. Ashton, Thomas G., M.D., Physician to the Philadelphia General Hospital. Wynnewood, Pa.

1920. Astley, George Mason, M.D., Assistant Surgeon, Samaritan Hospital. 5317 Master St.

1914. Austin, J. Harold, B.S. (Univ. of Penna.), M.D., Professor of Research Medicine, University of Pennsylvania. John Herr Musser Department of Research Medicine, University of Pennslyvania.

1906. Babbitt, James A., A.B. (Yale), A.M. (Haverford), M.D., Assistant Professor of Otolaryngology, University of Pennsylvania; Associate Professor of Otolaryngology, Graduate School of Medicine, University of Pennsylvania; Assistant Laryngologist and Aurist, Lankenau Hospital; Laryngologist, Mary Drexel Children's Hospital. 1912 Spruce St.

1910. Baer, Benjamin F., Jr., B.S., M.D., Associate Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Assistant Ophthalmologist, University Hospital; Attending Surgeon to Wills Eye Hospital; Ophthalmologist, Howard Hospital. 1927 Spruce St.

†1892. Baker, George Fales, B.S., M.D. 1818 Spruce St.

1911. Baldwin, James Harvey, A.B., M.D., Surgeon to the Methodist Hospital. 1426 Pine St.

ELECTED

1916. Balentine, Percival L., M.D., Assistant Surgeon, Wills Eye Hospital. 302 Weightman Building, 1524 Chestnut St.

1898. Balliet, Tilghman M., A.M., M.D., Professor of Therapeutics at Dartmouth College, Hanover, N. H.; Physician to the Old Man's Home. 3920 Sansom St.

1911. Barnard, Everett P., M.D., Obstetrician to the Maternity Hospital; Assistant Instructor in Obstetrics in the University of Pennsylvania. 1820 S. Rittenhouse Square.

1924. Bartle, Henry J., B. S., M.D., Clinical Assistant, Department for Disease of the Stomach and Bowels, Jefferson Medical College and Hospital. 501 Medical Arts Building.

1921. Bauer, Edward L., M.D., Professor of Children's Diseases, Jefferson Medical College; Pediatrist to the Jefferson and Memorial Hospitals and the Philadelphia Hospital for Contagious Diseases; Consulting Pediatrist, Germantown Hospital. 345 S. Nineteenth St.

1883. Baum, Charles, A.M., M.D., Ph.D. 1828 Wallace St.

1922. Bazett, Henry Cuthbert, M.A., M.D. (Oxon.), F.R.C.S. (England), Professor of Physiology, University of Pennsylvania. Bryn Mawr, Pa.

1908. Beardsley, Edward J. G., M.D., L.R.C.P. (Lond.), Clinical Professor of Medicine in the Jefferson Medical College; Chief Clinical Assistant in the Out-Patient Medical Department of the Jefferson Medical College Hospital; Assistant Physician to the Jefferson Hospital. 1919 Spruce St.

*1916. Bell, William Hemphill, M.D., Captain, Medical Corps, U. S. Navy; Commanding Officer, U. S. Naval Hospital, Newport, R. I.

1923. Bergey, David H., A.M., M.D., B.S., Dr. P.H., Professor of Hygiene and Bacteriology, University of Pennsylvania. 206 S. Fifty-third St.

*1903. Biggs, Montgomery H., M.D., Surgeon to the Rutherford Hospital; Chief Surgeon of the Carolina, Churchfield and Ohio Railway. Rutherfordton, N. C.

1918. Billings, Arthur E., M.D., Clinical Assistant in Surgery, Dept. B, Jefferson Medical College; Surgeon to Pennsylvania and Bryn Mawr Hospitals. 2020 Spruce St.

1917. Birdsall, Joseph C., A.B., A.M., M.D., Associate Professor of Urology in the Graduate School of Medicine, and Urologist to the Hospital of the Graduate School of Medicine, University of Pennsylvania; Assistant in Genito-urinary Dispensary, Presbyterian Hospital. 4610 Spruce St.

ELECTED

1908. Bland, Pascal Brooke, M.D., Professor of Obstetrics, Jefferson Medical College; Visiting Obstetrician, Jefferson Medical College; Gynecologist to St. Joseph's Hospital. 1621 Spruce Street.

1917. Block, Frank B., A.B., M.D., Surgeon to the Jewish Hospital; Associate in Gynecology in the University of Pennsylvania. Medical Arts Building.

1894. Bochroch, Max H., M.D., Professor of Nervous and Mental Diseases, Temple University; Visiting Physician to the Psychopathic Wards of the Philadelphia General Hospital. 1539 Pine St.

1896. Boger, John A., A.M., M.D., Surgeon to St. Mary's Hospital; Surgeon to the Stetson Hospital. 2213 N. Broad St.

1928. Boles, Russell S., M.D., Associate in Medicine, University of Pennsylvania; Assistant Visiting Physician, Philadelphia General Hospital; Consulting Gastroenterologist, U. S. Veterans' Bureau, Philadelphia. Rittenhouse Plaza.

1923. Bond Earl, D., A.B., M.D., Physician-in-Chief, Pennsylvania Hospital, Department for Mental and Nervous Diseases; Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. Bryn Mawr, Pa.

1911. Bonney, Charles W., A.B., M.D., Associate in Topograp and Applied Anatomy in the Jefferson Medical College. 1117 Spruce St.

1924. Boon, David J., M.D., Opthalmologist, Memorial Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Ophthalmic Surgeon, Episcopal Hospital. 1532 N. Fifteenth Street.

1921. Borzell, Francis Frank, M.D., Roentgenologist, Hospital; Chief Clinical Assistant, Roentgen Department, Jefferson Medical College; X-Ray Consultant, State Hospital for the Insane, Norristown, Pa. 4910 Frankford Ave.

1913. Boston, L. Napoleon, A.M., M.D., Professor of Physical Diagnosis, Graduate School of Medicine, and Associate in Medicine in the School of Medicine, University of Pennsylvania; Professor of Principles and Practice of Medicine and Clinical Medicine, Woman's Medical College; Physician to the Philadelphia General and Northwestern General Hospitals 1737 Chestnut St.

1928. Bothe, Albert Edward, B.S., M.D., M.S., Assistant Surgeon, Presbyterian Hospital; Assistant in Surgery, Graduate School of Medicine, University of Pennsylvania. Medical Arts Building.

ELECTED

1928. Bothe, Frederick A., M.D. Medical Arts Building.

1919. Bowen, David Ralph, M.D., Radiologist to the Pennsylvania Hospital. 82 W. Lacrosse Ave., Lansdowne, Pa.

1923. Bower, John O., M.D. 2008 Walnut St.

1891. Boyd, George, M., M.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Consultant to the Philadelphia Lying-in Charity; Consulting Obstetrician to the Preston Retreat. 1909 Spruce St.

1907. Boyer, Henry Percival, M.D., Neurologist to the Stetson Hospital; Physician to the Philadelphia Home for Incurables; Medical Electrician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 4602 Baltimore Ave.

1[illegible]5. Boykin, Irvine M., M.D., Associate Surgeon to the Episcopal Hospital; Associate in Surgery, Graduate School of Medicine, Instructor in Surgery, School of Medicine, University of Pennsylvania. 922 Medical Arts Building.

1907. Bradley, William N., Ph.G., M.D., Visiting Pediatrist to Howard Hospital; Visiting Pediatrist to Philadelphia General Hospital; Associate in Pediatrics, School of Medicine, University of Pennsylvania; Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania. 1725 Pine St.

1921. Bransfield, John W., M.D., Clinical Professor of Surgery, Woman's Medical College; Visiting Surgeon to St. Agnes, St. Vincent's and Woman's College Hospitals. 2025 Walnut Street.

[illegible]nson, Thomas F., M.D., Attending Physician to the [illegible]ryn Mawr Hospital. Rosemont, Pa.

1891. Brinton, Lewis, M.D., Physician-in-Chief to the American Hospital for Diseases of the Stomach. 1301 Medical Arts Bulding., Sixteenth and Walnut Sts.

1900. Brinton, Ward, A.M., M.D., Chief of Division of Tuberculosis, Department of Public Health of Philadelphia; Clinical Professor of Medicine, Woman's Medical College of Pennsylvania; Visiting Physician, Department for Tuberculosis, Philadelphia General Hospital, and Eaglesmere Sanatorium. 1423 Spruce St.

1917. Bromer, Ralph S., A.B. (Yale), M.D., Associate in Radiology, Graduate School of Medicine, and Instructor in Roentgenology, School of Medicine, University of Pennslyvania; Roentgenologist to the Episcopal, the Orthopedic and the Children's Hospitals. 504 W. Mt. Airy Ave.

ELECTED

1919. Brown, Henry P. Jr., M.D., Surgeon and Chief of Out-Patient Clinic of the Pennsylvania Hospital; Surgeon to the Children's Hospital; Associate Surgeon, Presbyterian Hospital; Instructor in Surgery in the School of Medicine, and Associate in Surgery in the Graduate School of Medicine, University of Pennsylvania. 624 Medical Arts Building.

1916. Brown, Samuel Horton, M.D. 1901 Mt. Vernon St.

1887. Brubaker, Albert P., A.M., M.D., Emeritus Professor of Physiology and Medical Jurisprudence in the Jefferson Medical College. 3426 Powelton Ave.

1916. Buckley, Albert Coulson, M.D., Medical Superintendent, Friends' Hospital, Frankford; Associate Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania. Frankford, Phila.

1928. Burden, Verne G., M.D., M.S., Surgeon to St. Joseph's Hospital; Assistant Surgeon, St. Mary's Hospital; Instructor in Surgery, Graduate School of Medicine, University of Pennsylvania; F. M. Kirby Fellow in Surgical Physiology, Medical School, University of Pennsylvania. 1912 Pine St.

1927. Burns, Michael A., M.D., Assistant Professor Nervous and Mental Diseases, Jefferson Medical College; Chief of the Nervous and Mental Clinic, Jefferson Hospital; Visiting Neurologist, Philadelphia General Hospital; Neuropsychiatrist, St. Mary's Hospital. N. E. Cor. Twentieth and Chestnut Sts.

1906. Burns, Stillwell C., M.D., Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 1925 Spring Garden St.

1892. Burr, Charles W., M.D., Professor of Mental Diseases in the University of Pennsylvania; Neurologist to the Philadelphia General Hospital. 1918 Spruce St.

1906. Butler, Ralph, M.D., Professor of Laryngology in the Graduate School of Medicine, University of Pennsylvania; Laryngologist and Aurist to the Lankenau Hospital. 2007 Chestnut Street.

*1908. Cadbury, William W., A.M., M.D., Canton Christian College, Canton, China.

†1907. Cadwalader, Williams B., M.D., Assistant Professor of Neurology, School of Medicine, University of Pennsylvania; Neurologist to the Presbyterian Hospital; Consulting Neurologist to the Bryn Mawr Hospital. 133 S. Thirty-sixth St.

1928. Campbell, Edward H., M.D., Assistant Otolaryngologist, Pennsylvania and Children's Hospitals, and in Out-Patient

ELECTED

Department of Lankenau Hospital; Instructor in Otolaryngology in the Medical School and Graduate School of Medicine, University of Pennsylvania. 2117 Chestnut St.

1905. Carmany, Harry S., M.D., Surgeon to Memorial Hospital, Roxborough; Associate Surgeon of the Episcopal Hospital. 366 Green Lane, Roxborough.

‡1924. Carncross, Horace, M.D., 1003 Spruce St.

1910. Carnett, John Berton, M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate in Surgery, Medical Department, University of Pennsylvania; Surgeon to Philadelphia General Hospital; Chief Surgeon to the American Stomach Hospital. 2012 Spruce St.

1905. Carpenter, Herbert B., M.D. 1805 Spruce St.

1926. Carpenter, Howard Childs, M.D., Vice-Dean for Pediatrics and Professor of Pediatric Hygiene, Graduate School of Medicine, University of Pennsylvania; Assistant Professor of Pediatrics, School of Medicine, University of Pennsylvania; Director, Department for the Prevention of Disease, Children's Hospital. 1805 Spruce St.

1895. Carpenter, John T., M.D., Attending Ophthalmologist to the Bryn Mawr Hospital 1737 Chestnut St.

1917. Carson, John B., M.D., Physician to Episcopal Hospital; Assistant Physician, Pennsylvania Hospital. 1802 Pine Street.

1922. Case, Eugene A., M.D., Professor of Morbid Anatomy, Graduate School of Medicine, University of Pennsylvania; Assistant Pathologist, Philadelphia General Hospital. Lansdowne, Pa.

1892. Cattell, Henry W., A.M., M.D. Cookestown, N. J.

1900. Chance, Burton, M.D., Attending Surgeon to the Wills Eye Hospital; Consulting Ophthalmologist Eastern Pennsylvania Institution for the Feeble-minded and Epileptics; Ophthalmic Surgeon to the Pennsylvania Railroad Company. 315 S. Fifteenth St.

1897. Cheston, Radcliffe, M.D., Visiting Physician to the Chestnut Hill Hospital; Consulting Physician to the Germantown Hospital and the the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill.

1903. Chrystie, Walter, M.D. One of the Senior Physicians to Bryn Mawr Hospital. Bryn Mawr, Pa.

1926. Clarke, J. Alexander, A.B., M.D., Chief Clinical Assistant, Out-Patient Department of Applied Immunology, Jefferson Hospital; Assistant Physician, Philadelphia General Hospital;

ELECTED

Instructor in Medicine, Undergraduate School, University of Pennsylvania. 334 S. Twenty-first St.

1926. Clerf, Louis H., M.D., Instructor in Bronchoscopy and Esophagoscopy and Demonstrator of Laryngology, Jefferson Medical College; Assistant Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, University of Pennsylvania; Chief Clinical Assistant in Bronchoscopy and Esophagoscopy, Jefferson Hospital; Assistant in Bronchoscopy and Esophagoscopy, University Hospital. 1216 Walnut Street.

1910. Cloud, J. Howard, M.D., Attending Physician to the Bryn Mawr Hospital. 11 W. Montgomery Ave., Ardmore, Pa.

1903. Coates, George Morrison, A.B., M.D., Professor of Otology, Graduate School of Medicine, University of Pennsylvania; Associate Surgeon, Ear, Throat and Nose, Pennsylvania Hospital; Consulting Laryngologist to the Philadelphia Orphanage and to the Sharon Hospital, Sharon, Conn. 1721 Pine St.

1908. Codman, Charles A. E., M.D., Physician to the American Oncologic Hospital. 4116 Spruce St.

1922. Cohen, Leon Solis, A.B., M.D., Clinical Assistant of Roentgenology, Jefferson Medical College. 1923 Spruce St.

1907. Cohen, Myer Solis, A.B., M.D., Assistant Professor of Medicine, Graduate School of Medicine, University of Pennsylvania; Lecturer on Medical Jurisprudence, Woman's Medical College of Pennsylvania; Director of the Jules E. Mastbaum Research Laboratory of the Jewish Hospital; Pediatrist to the Mt. Sinai Hospital. 2029 Spruce St.

1888. Cohen, Solomon Solis, M.D., Emeritus Professor of Clinical Medicine in the Jefferson Medical College; Emeritus Professor of Medicine and Therapeutics, Philadelphia Polyclinic and College for Graduates in Medicine; Consulting Physician to the Jewish Hospital and to the Rush Hospital. 1906 Walnut St.

1920. Cole, Charles J., A.B., M.D., Visiting Physician, Philadelphia Hospital for Contagious Diseases; Physician to Out-Patient Department, Mary Drexel Home. Elkins Park, Pa.

1898. Coles, Stricker, M.D. Bryn Mawr, Pa.

*1901. Coley, Thomas Luther, A.B., M.D., Major, Medical Corps, U. S. Army. Fort Davis, Canal Zone.

‡1903. Coplin, W. M. L., M.D., Professor of Pathology in the Jefferson Medical College; Pathologist to and Director of the Laboratories of the Jefferson Medical College Hospital; Pathologist

ELECTED

to the Philadelphia General Hospital and to the Friends' Asylum for the Insane, Frankford; Bacteriologist to the Pennsylvania State Board of Health. Albany Apartments, Atlantic City, N. J.

1912. Copp, Owen, A.B., M.D., Consultant for the Future Development of the Pennsylvania Hospital. 4401 Market St.

1911. Cornell, Walter Stewart, A.B., M.D., Director of Medical Inspection of Public Schools of the City of Philadelphia; Chief of Medical Staff of the House of Detention; Lecturer on Osteology in the University of Pennsylvania. 1919 Cherry Street.

1914. Corson, Edward Foulke, M.D., Assistant Professor of Dermatology, Jefferson Medical College; Associate in Dermatology, Graduate School of Medicine, University of Pennsylvania; Dermatologist, Children's Hospital of Philadelphia. Medical Arts Building.

1907. Council, Malcolm S., M.D., Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Cathcart Home at Devon. Bryn Mawr, Pa.

1924. Cowan, Alfred, M.D., Assistant Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist, Philadelphia General Hospital. 2007 Pine St.

1904. Craig, Frank A., M.D., Instructor in Medicine in the University of Pennsylvania; Visiting Physician to the Henry Phipps Institute, University of Pennsylvania; Visiting Physician to the White Haven Sanatorium; Tuberculosis Consultant to the Presbyterian Hospital. 2011 Pine Street.

1907. Crampton, George S., M.D., Attending Surgeon to the Eye Department of the Pennsylvania Hospital and the Philadelphia Hospital for Contagious Diseases; Assistant Surgeon to the Wills Hospital; Professor of Ophthalmology in the Graduate School of Medicine, University of Pennsylvania; Ophthalmologist to the Philadelphia Orphanage. 2031 Locust St.

1924. Crawford, Baxter Lindsey, M.D., Associate in Pathology, Jefferson Medical College; Chief of Laboratory Service, Jefferson Hospital; Assistant Pathologist, Philadelphia General Hospital. Jefferson Hospital, Tenth and Sansom Sts.

1920. Creighton, William J., B.A., M.D., Assistant Ophthalmic Surgeon, Germantown Hospital and Dispensary; Assistant Dispensary Surgeon, Department Ophthalmology, University Hospital; Instructor in Ophthalmology, University of Pennsylvania Medical School. 258 S. Eighteenth St.

ELECTED

1920. Cross, George Howard, M.D., Ophthalmologist to the Chester Hospital; Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania. Chester, Pa.

1917. Cross, Sumner H., A.B., M.D., Physician to the Abington Memorial Hospital, Abington, Pa. 412 York Road, Jenkintown, Pa.

1921. Crossan, Edward T., M.D., Associate Surgeon, Episcopal Hospital; Associate in Surgery, University of Pennsylvania; Assistant Surgeon Orthopedic Hospital. 257 S. Sixteenth Street.

*1924. Crowell, Bowman C., A.B., M.D., C.M., Associate Director, American College of Surgeons; Director of Clinical Research. 40 E. Erie St., Chicago, Ill.

1904. Cruice, John M., M.D., Physician to St. Agnes and St. Joseph's Hospitals and to the Henry Phipps Institute of the University of Pennsylvania; Instructor in Medicine in the University of Pennsylvania. 406 S. Twenty-second St.

*1910. Cummins, W. Taylor, M.D., Pathologist to the Southern Pacific Hospital; Director of the Mary W. Harriman Research Laboratory, San Francisco, Calif.

1902. Currie, Charles A., M.D., Physician to the Germantown Hospital. West Walnut Lane, Germantown.

1896. Da Costa, John Chalmers, M.D., Professor of the Principles of Surgery and of Clinical Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General and St. Joseph's Hospital. 2045 Walnut St.

1887. Daland, Judson, M.D., Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 317 S. Eighteenth St.

1919. Davies, John R., Jr., M.D., Chief to the Out-Patient Nose, Throat and Ear Department of the Pennsylvania, Bryn Mawr and Chestnut Hill Hospitals. 302 S. Nineteenth St.

1896. Davis, Charles N., M.D., Dermatologist to the Pennsylvania Hospital; Consulting Dermatologist to St. Agnes' Hospital; Assistant Physician to the Dispensary for Skin Diseases in the Howard Hospital. 1931 Spruce St.

1916. Davis, Warren B., M.D., Rhinologist, Laryngologist, and Otologist, St. Agnes' Hospital; Instructor in Surgery, Jefferson Medical College; Assistant Surgeon, Frankford Hospital. 135 S. Eighteenth St.

1900. Davisson, Alex. Heron, M.D. 4514 Springfield Ave.

ELECTED

1894. Deaver, Harry C., M.D., Surgeon to the Episcopal Hospital and to the Children's Hospital of the Mary J. Drexel Home; Surgeon-in-Chief to the Kensington Hospital for Women. 337 S. Eighteenth St.

1887. Deaver, John B., M.D., D.Sc., LL.D., Professor of Surgery in the Graduate School of Medicine; Emeritus Professor of Surgery in the School of Medicine, University of Pennsylvania; Surgeon-in-Chief to the Lankenau Hospital. 1830 DeLancey Street.

1902. Dehoney, Howard, M.D. 240 S. Thirteenth St.

1924. Deichler, L. Waller, M.D., Assistant Surgeon, Wills Hospital; Instructor in Ophthalmology, University of Pennsylvania; Ophthalmologist, Philadelphia General Hospital. 1737 Chestnut St.

1923. De Long, Perce, M.D., Associate in Ophthalmic Pathology in the Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, Wills Eye Hospital; Assistant Neuropathologist, Philadelphia General Hospital. 1904 Chestnut Street.

1885. Dercum, Francis X., A.M., M.D., Ph.D., Sc.D., President, American Philosophical Society, Professor Emeritus of Nervous and Mental Diseases in the Jefferson Medical College; Foreign Corresponding Member of the Neurological Society of Paris; Honorary Member of the Psychiatric and Neurological Society of Vienna; Corresponding Member of the Neurological Section of the Royal Society of Medicine; Chevalier de l'Ordre National de la Légion d'Honneur. 1719 Walnut St.

1928. Dewees, A. Lovett, B.A., M.D., Attending Physician, Bryn Mawr Hospital. Haverford, Pa.

1912. Dewey, J. Hiland, Ph.B., M.D., Assistant Surgeon to Wills Hospital; Ophthalmic Surgeon to St. Francis' Hospital, Trenton, N. J. 1436 Diamond St.

*1911. Dickson, Frank D., M.D. 1807 Federal Reserve Bank Building, Kansas City, Mo.

1908. Dillard, Henry K., Jr., M.D., Physician to the Out-Patient Department of the Pennsylvania Hospital; Physician to the Dispensary of the Mary J. Drexel Home. 234 S. Twentieth Street.

1924. Dillon, Edward S., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Assistant Instructor in Medicine, School of Medicine, University of Pennsylvania. 2040 Pine St.

ELECTED

1920. Diven, John, A.B., M.D., Pediatrician to St. Christopher's Hospital and Babies' Hospital of Philadelphia. 326 S. Nineteenth St.

1920. Doane, Joseph Chapman, M.D., Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. Philadelphia General Hospital.

*1897. Dorland, W. A. Newman, A.M., M.D., Professor of Gynecology in the Post-graduate Medical School of Chicago; Professor of Obstetrics in the Chicago College of Medicine and Surgery; Visiting Obstetrician to Cook County Hospital. 185 N. Wabash Ave., Chicago, Ill.

1907. Dorrance, George Morris, M.D., Professor of Maxillo-Facial Surgery, Thomas Evans Institute, University of Pennsylvania; Surgeon to St. Agnes' Hospital. 2025 Walnut St.

1902. Downs, Robert N., Jr., M.D., Surgeon to the Dispensary of the Germantown Hospital. 6008 Greene St. Germantown.

1910. Drayton, William, Jr., M.D., Physician to the Philadelphia Hospital for Contagious Diseases; Physician to the Pennsylvania Institute for the Instruction of the Blind 1820 Pine Street.

1911. Earnshaw, Henry Culp, M.S., M.D., Attending Physician to the Hospital of the Good Shepherd, Rosemont; Assistant Attending Physician to the Bryn Mawr Hospital; Attending Physician to the Bryn Mawr Children's Hospital; Pennsylvania Railroad Surgeron. Bryn Mawr, Pa.

*1887. Edwards, William A., M.D., Professor of Pediatrics in the Medical Department of the University of California. R. D. 2, Box 105, El Cajon, Calif.

1924. Egbert, Seneca, M.D., Professor of Hygiene, School of Hygiene and Public Health, University of Pennsylvania. Wayne, Pa.

1911. Eliason, Eldridge L., B.A., M.D., Sc.D., Professor of Clinical Surgery in the University of Pennsylvania; Surgeon to the University Hospital and to the Howard Hospital; Assistant Surgeon to the Philadelphia General Hospital and the American Stomach Hospital. 326 S. Nineteenth St.

1928. Ellison, Richard T., B.S., M.D., Instructor in Medicine, School of Medicine, University of Pennsylvania; Assistant Physician in Charge of Heliotherapy at the Home for Consumptives, Chestnut Hill; Assistant Physician, Presbyterian Hospital. 8526 Germantown Ave.

1904. Elmer, Walter G., B.S., M.D., Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Orthopedic Surgery in the Woman's

ELECTED

Medical College of Pennsylvania; Orthopedic Surgeon to the Hospital of the Graduate School of Medicine and to the Philadelphia General Hospital. 1801 Pine St.

1896. Ely, Thomas C., A.M., M.D. 3912 Chestnut St.

1893. Eshner, Augustus A., M.D., Consulting Physician to Mercy Hospital. 1019 Spruce St.

*1905. Evans, Joseph S., Jr., A.B., M.D., Professor of Medicine, Medical School, University of Wisconsin; Physician to State of Wisconsin General Hospital; Consulting Physician, Madison General and St. Mary's Hospitals. 1300 University Ave., Madison, Wis.

1905. Evans, William, M.D. 500 W. Gay St., West Chester.

1912. Eves, Curtis C., M.D., Otolaryngologist to the Pennsylvania Hospital; Consultant Otolaryngologist to the Philadelphia General Hospital. 1910 Spruce St.

1922. Farley, David L., B.S., M.D., Associate in Medicine, University of Pennsylvania; Physician to Pennsylvania Hospital; Chief of Out-Patient Medical Clinic, Pennsylvania Hospital. 1725 Pine St.

†1903. Farr, Clifford B., A.M., M.D., Director of Laboratories, Pennsylvania Hospital, Department for Mental and Nervous Diseases. Bryn Mawr, Pa.

1893. Farr, William W., M.D., Physician to the Leamy Home. 121 Maplewood Ave., Germantown.

1884. Fenton, Thomas H., M.D. 1319 Spruce St.

1907. Fetterolf, George, A.B., M.D., Sc.D., Professor of Otolaryngology, School of Medicine, University of Pennsylvania. 2010 Spruce St.

1924. Fewell, Alexander G., M.D., Assistant Professor of Ophthalmology, Graduate School of Medicine and Instructor in Ophthalmology in the School of Medicine, University of Pennsylvania; Ophthalmic Surgeon to the Episcopal Hospital. 1924 Pine St.

1907. Fife, Charles A., A.B., M.D., Associate Professor of Pediatrics in the Graduate School of Medicine of the University of Pennsylvania; Pediatrist to the Presbyterian Hospital; Physician to the St. Christopher's Hospital for Children; Assistant Physician to the Philadelphia General Hospital. 2104 Spruce St.

1884. Fisher, Henry M., A.B., M.D. Jenkintown, Pa.

1910. Fisher, John Monroe, M.D., Associate Professor of Gynecology in the Jefferson Medical College; Gynecologist to the

ELECTED

Philadelphia, St. Agnes' and Pottstown Hospitals; Assistant Gynecologist to the Jefferson Medical College Hospital. 345 S. Nineteenth St.

1928. Fitz-Hugh, Thomas, Jr., A.B., A.M., M.D., Assistant Attending Physician, University Hospital; Attending Physician, Delaware County Hospital; Instructor in Medicine, University of Pennsylvania. 2020 Locust St.

1928. Flick, John Bernard, M.D., Chief Clinical Assistant in Surgery, Division B, Jefferson Hospital; Assistant Surgeon, Pennsylvania and Bryn Mawr Hospitals; Surgeon, Eagleville Sanatorium for Consumptives, Eagleville, Pa. 1608 Spruce Street.

1888. Flick, Lawrence F., M.D. 736 Pine St.

1916. Forst, John R., M.D. 166 W. Coulter St., Germantown.

1908. Foulkrod, Collin, M.D., Obstetrician to the Presbyterian Hospital; Assistant Demonstrator of Obstetrics in Jefferson Medical College. 3910 Chestnut St.

1908. Fox, Herbert, M.D., Director of the William Pepper Clinical Laboratory and Professor of Comparative Pathology, School of Medicine, University of Pennsylvania; Pathologist to the Laboratory of Comparative Pathology of the Zoölogical Society of Philadelphia; Pathologist to the Rush Hospital. Haverford, Pa.

†1885. Fox, Joseph M., M.D. Torresdale, Pa.

1906. Fraley, Frederick, Jr., A.B., M.D., Associate in Pediatrics, Graduate School of Medicine, University of Pennsylvania. Overbrook, Pa.

1897. Frazier, Charles H., A.B., M.D., Sc.D., John Rhea Barton Professor of Surgery, University of Pennsylvania. 133 S. Thirty-sixth St.

1928. Fuller, Daniel Hunt, A.B., A.M., M.D., Medical Director, Department for Men, Pennsylvania Hospital for Mental and Nervous Diseases. 111 N. Forty-ninth St.

1916. Funk, Elmer Hendricks, M.D., Clinical Professor of Medicine and Therapeutics in the Jefferson Medical College; Assistant Physician to the Pennsylvania and Jefferson Hospitals; Visiting Physician to the White Haven Sanatorium. 1318 Spruce St.

1899. Gamble, Robert, G., M.D., one of the Attending Physicians to the Bryn Mawr Hospital. Haverford, Pa.

1912. Gaskill, Henry Kennedy, M.D. S. E. Cor. Nineteenth and Spruce Sts.

ELECTED

*1913. Gates, Nathaniel, M.D. 10 Peterboro Ave., Detroit, Mich.

1917. Gerhard, Arthur Howell, M.D. 1615 N. Delaware Ave.

1902. Ghriskey, Albert A., M.D. 3936 Walnut St.

1899. Gibbon, John H., M.D., Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania Hospital and Consulting Surgeon to the Bryn Mawr Hospital. 1608 Spruce Street.

1920. Gill, A. Bruce, A.B., M.D., Professor of Orthopedics, University of Pennsylvania; Surgeon to the Orthopedic Hospital; Orthopedic Surgeon to the Presbyterian Hospital; Chief Surgeon to the Widener Memorial Industrial Training School for Crippled Children. The Lenox, Thirteenth and Spruce Streets.

1927. Gilmour, William Rodger, A.B., A.M., M.D., Assistant Surgeon, Philadelphia General and Methodist Hospitals; Instructor in Anatomy, University of Pennsylvania; Associate Professor of Operative Surgery and Surgical Anatomy, Woman's Medical College. 1737 Chestnut St.

1897. Girvin, John H., M.D., Gynecologist to the Presbyterian Hospital; Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania. 2120 Walnut St.

1920. Githens, Thomas Stotesbury, M.D., Chief Pharmacologist, H. K. Mulford Company. Alden Park Manor, Germantown.

1906. Gittings, J. Claxton, M.D., Professor of Pediatrics, School of Medicine and Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Children's Hospital of Philadelphia. 1828 Pine St.

1905. Given, Ellis E. W., M.D., Surgeon to the Philadelphia Freemasons Memorial Hospital of the Masonic Home, Elizabethtown, Pa. 2714 Columbia Ave.

1894. Gleason, E. B., S.B., M.D., LL.D., Professor of Otology in the Graduate School of Medicine, University of Pennsylvania. 2112 Pine St.

1906. Goepp, R. Max, M.D. 518 Medical Arts Building.

1906. Goldberg, Harold G., M.D., Ophthalmic Surgeon to the Episcopal and Misericordia Hospitals, Kensington Hospital for Women and Baltimore and Ohio Railroad. 2213 Walnut Street.

*1908. Goodman, Edward H., M.D. Dorset, Vt.

1905. Gordon, Alfred, M.D., Neurologist to the Mt. Sinai, the Northwestern General, and the Douglass Memorial Hospitals. 1812 Spruce St.

ELECTED

1928. Gordon, Burgess Lee, A.B., M.D., Director and Physician-in-Charge of Department for Diseases of the Chest, Jefferson Hospital; Assistant Physician, Out-Patient Department, Pennsylvania Hospital; Demonstrator of Medicine, Jefferson Medical College. 1832 Spruce St.

1894. Graham, Edwin E., M.D., Professor of Pediatrics in the Jefferson Medical College; Pediatrist to the Jefferson and the Philadelphia General Hospitals; Physician to the Franklin Reformatory Home. 1713 Spruce St.

1926. Grant, Francis C., A.B., M.D., Assistant Professor of Neurosurgery and Associate in Surgery, School of Medicine, University of Pennsylvania; Associate in Neuro-Surgery, Graduate School of Medicine, University of Pennsylvania; Visiting Surgeon, Department of Neurological Surgery, Philadelphia General Hospital. 133 S. Thirty-sixth St.

1904. Grayson, Charles P., M.D., Emeritus Professor of Laryngology in the University of Pennsylvania; Otolaryngologist to the Philadelphia General Hospital. 262 S. Fifteenth St.

1910. Greenman, Milton J., M.D., Sc.D., Director of the Wistar Institute of Anatomy and Biology. Wistar Institute of Anatomy and Biology, Thirty-sixth St. and Woodland Ave.

1883. Griffith, J. P. Crozer, A.B., M.D., Ph.D., Professor of Pediatrics in the Graduate School of Medicine, University of Pennsylvania; Corresponding Member of the Société de Pédiatrie de Paris; Physician to the Children's Hospital of Philadelphia. 1810 Spruce St.

1912. Griscom, J. Milton, B.S., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Attending Surgeon to the Wills Hospital. 2213 Walnut St.

1911. Gummey, Frank Bird, M.D., Visiting Physician to the Germantown Hospital and Dispensary; Visiting Physician to the Midnight Mission. 5418 Greene St., Germantown.

*1902. Gwyn, Norman B., M.D., Clinician in Medicine, Toronto General Hospital; Clinician in Medicine, Medical Faculty, University of Toronto School. 109 Madison Ave., Toronto, Canada.

1894. Hamill, Samuel McC., M.D., Pediatrist to the Presbyterian Hospital; Pediatrist to St. Vincent's Home. 1822 Spruce St.

1897. Hand, Alfred, Jr., M.D., Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Children's Hospital, to the Children's Hospital of the Mary J. Drexel Home and to the Methodist Hospital. 1724 Pine St.

ELECTED

1886. Hansell, Howard F., M.D., Emeritus Professor of Ophthalmology in the Jefferson Medical College. N. E. Cor. Seventeenth and Walnut Sts.

1889. Hare, Hobart A., M.D., LL.D., Professor of Therapeutics, Materia Medica, and Diagnosis in the Jefferson Medical College. 1801 Spruce St.

1903. Hart, Charles D., A.M., M.D., Inspector and Secretary of the Eastern State Penitentiary; National Executive Committee and Chairman of the Philadelphia Committee, Boy Scouts of America. Chestnut Hill.

1926. Hartman, Frederick L., A.B., M.D., Clinical Associate in Medicine, Lankenau Hospital; Assistant Instructor in Pathology, University of Pennsylvania; Assistant Pathologist, Visiting Staff of University and Philadelphia General Hospitals. 1914 Pine St.

1907. Hatfield, Charles James, A.B. (Princeton), M.D., Executive Director of the Henry Phipps Institute for the Study, Treatment, and Prevention of Tuberculosis; Visiting Physician to the White Haven Sanatorium. Phipps Institute, Seventh and Lombard Sts.

1928. Hayman, Joseph M., A.B., M.D., Physician to Pennsylvania Hospital; Instructor in Pharmacology, Medical School, University of Pennsylvania. 422 W. Price St., Germantown.

1911. Heed, Charles R., M.D., Ophthalmologist to Girard College; Assistant Ophthalmologist to the Jefferson Medical College Hospital. 1205 Spruce St.

‡1908. Heineberg, Alfred P. D., M.D., Associate in Gynecology in the Jefferson Medical College; Assistant Gynecologist to St. Agnes' Hospital. 1923 Spruce St.

1901. Heisler, John C., M.D., Professor of Anatomy, University of Pennsylvania. 3829 Walnut St.

1903. Henry, J. Norman, M.D., Physician to the Pennsylvania Hospital; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania; Assistant Physician to the Philadelphia General Hospital. 1906 Spruce St.

1927. Herman, Leon, B.S., M.D., Urologist, Methodist Hospital; Assistant Surgeon in Charge of Urology, Pennsylvania Hospital. 1521 Pine St.

1891. Hewson, Addinell, A.B., A.M., M.D., Professor of Anatomy and Histology in the Temple University; Surgeon to Memorial Hospital, Roxborough. 257 S. Sixteenth St.

1924. Hewson, William, A.B., M.D., Assistant in Otology, Graduate School of Medicine, University of Pennsylvania; Oto-

ELECTED

laryngologist, Pennsylvania Institution for Instruction of Blind and the Shriners' Hospital for Crippled Children; Assistant Otolaryngologist, Memorial Hospital. 6300 Overbrook Ave.

1909. HIGBEE, WILLIAM S., M.D., President of the Pennsylvania State Board of Examiners for Registration of Nurses. 5121 Pine St.

1897. HINKLE, WILLIAM M., M.D., Associate in Otology in the Graduate School of Medicine, University of Pennsylvania; Lecturer on the Anatomy and Physiology of the Vocal Organs in the National School of Elocution and Oratory. 923 N. Sixty-fourth St.

*1892. HINSDALE, GUY, A.M., M.D. Hot Springs, Virginia.

*1888. HIRSH, A. BERN, M.D., Consulting Physician for Physiotherapy, Beth Israel Hospital. 67 W. Ninety-fourth St., New York City.

1888. HIRST, BARTON COOKE, A.B., M.D., LL.D., Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Gynecologist to the Philadelphia General and the Howard Hospitals. 1821 Spruce St.

1924. HIRST, JOHN C., 2nd, A.B., M.D., Assistant Professor of Obstetrics, School of Medicine, and Associate in Obstetrics, Graduate School of Medicine, University of Pennsylvania; Assistant Obstetrician, University Hospital; Obstetrician to St. Agnes' Hospital; Gynecologist to Orthopedic Hospital. 1918 Pine St.

*1908. HITCHENS, ARTHUR PARKER, M.D., M.C., U.S.A. Army Medical School, Washington, D. C.

1905. HODGE, EDWARD BLANCHARD, A.B., M.D., Surgeon to the Presbyterian and the Germantown Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania; Associate Surgeon to the Pennsylvania Hospital; Surgeon-in-Chief to Chester County Hospital, West Chester, Pa. 2019 Spruce St.

1906. HOLLOWAY, THOMAS B., M.S., M.D., Sc.D., Professor of Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist, Orthoepdic Hospital, and in Department of Neurology, Philadelphia General Hospital; Ophthalmologist to the Pennsylvania Institution for the Instruction of the Blind at Overbrook. 1819 Chestnut Street.

1914. HOOKER, RICHARD S., M.D., Assistant Physician to the Episcopal Hospital, and to the Philadelphia Orthopedic Hospital and Infirmary for Nervous Diseases. 2147 N. Howard St.

1919. HOPKINS, ARTHUR H., B.S. (Haverford), M.D. 1726 Pine St.

1925. HOPKINSON, R. DALE, M.D., Registrar and Assistant Physician, Abington Memorial Hospital. Jenkintown, Pa.

ELECTED

1928. Houser, Karl M., Ph.B., M.D., M.Sc., Instructor in Otolaryngology, University of Pennsylvania; Assistant in Otolaryngology, University Hospital; Otolaryngologist, Delaware County Hospital. 1826 Pine St.

1908, Hoyt, Daniel M., M.D., Assistant Visiting Physician to the Philadelphia General Hospital. The Tracy, Thirty-sixth and Chestnut Sts.

*1912. Huber, G. Carl, M.D., Professor of Anatomy and Director of the Anatomic Laboratories and Dean of the Graduate School, University of Michigan. 1330 Hill St., Ann Arbor, Mich.

1892. Hughes, William E., M.D., Visiting Physician to the Philadelphia General Hospital; Consulting Physician to the Presbyterian Hospital. 3945 Chestnut St.

1923. Hume, John E., A.B., M.D., Visiting Physician, Medical Department, Howard Hospital. N. E. Cor. Twentieth and Chestnut Sts.

*1912. Hunter, John W., B.S., M.D. McDaniel, Md.

1921. Hunter, Robert J., M.D., Laryngologist, Philadelphia General Hospital; Chief of Dispensary and Assistant Laryngologist and Aurist, Howard Hospital; Associate in Otology, University of Pennsylvania, Graduate School. 2011 Chestnut Street.

1926. Husik, David N., M.D., Associate in Otolaryngology, University of Pennsylvania; Instructor in Otology, Graduate School of Medicine, University of Pennsylvania; Laryngologist and Otologist, Philadelphia General Hospital; Assistant Otolaryngologist, University Hospital. 1610 Spruce St.

1898. Hutchinson, James P., M.D., Consulting Surgeon to the Pennsylvania and to the Methodist Hospitals. Penn Mutual Life Insurance Company, Sixth and Walnut Sts.

1921. Ivy, Robert H., D.D.S., M.D., Professor of Maxillo-Facial Surgery, Graduate School of Medicine, University of Pennsylvania; Plastic Surgeon to the Hospitals of the Graduate School of Medicine, University of Pennsylvania; Oral Surgeon, Episcopal Hospital; Consultant in Maxillo-Facial Surgery, Walter Reed General Hospital, Washington, D.C. 1503 Medical Arts Building.

1917. Jackson, Chevalier, M.D., Sc.D., Professor of Bronchoscopy and Esophagoscopy, Jefferson Medical College; Professor of Bronchoscopy and Esophagoscopy, School of Medicine and

ELECTED

Graduate School of Medicine, University of Pennsylvania; Lecturer on Bronchoscopy and Esophagoscopy, Woman's Medical College. 235 S. Fifteenth St.

*1885. Jackson, Edward, A.M., M.D., Sc.D., Emeritus Professor of Ophthalmology in the University of Colorado; Emeritus Professor of Diseases of the Eye in the Philadelphia Polyclinic; Secretary of State Commission for the Blind of Colorado. 217 Imperial Building, Denver, Colo.

1906. Jacobs, Francis Brinton, B.S., M.D., Pediatrist to the Chester County Hospital. West Chester, Pa.

1922. Jameson, Howard Leon, M.D., Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 2133 S. Sixteenth St.

1920. Janvier, G. Victor, M.D., Associate in Obstetrics, School of Medicine, University of Pennsylvania; Assistant Obstetrician, University Hospital; Assistant Obstetrician and Gynecologist, Philadelphia General and Howard Hospitals; Cystoscopist to the Obstetric and Gynecologic Department of the Delaware County Hospital. Lansdowne, Pa.

1913. Jefferys, William Hamilton, A.B., A.M., M.D. Rosemont, Pa.

1919. Jenks, Horace H., A.B., M.D., Medical Director, Associated Medical Clinics; Assistant Visiting Physician to the Children's Hospital; Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Physician to St. Christopher's Hospital for Children. 918 Clinton St.

1928. John, Rutherford Lewis, B.S., M.D., Instructor in Surgery, School of Medicine, University of Pennsylvania; Associate Surgeon in Charge of Orthopedics, Episcopal Hospital; Orthopedic Surgeon to St. Christopher's Hospital; Assistant Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases. 256 S. Twenty-first St.

1926. Johnson, George Ernest, M.D. 5341 Chester Ave.

1898. Johnson, Russell H., A.B. (Princeton), M.D., Physician to the Pennsylvania Institution for the Deaf and Dumb. Chestnut Hill, Philadelphia.

1928. Johnson, William N., A.B., M.D., Consulting Physician, Germantown Hospital. 6430 Germantown Ave.

1918. Jonas, Leon, M.D. 1726 Pine St.

1900. Jones, Charles James, A.M., M.D., LL.D., Ophthalmic Surgeon to St. Joseph's Hospital; Ophthalmic Surgeon to the House of the Good Shepherd, Germantown; Consulting Ophthalmologist to St. Vincent's Home. 626 Medical Arts Building.

ELECTED

1924. Jones, Harold W., M.D., Demonstrator of Medicine, Jefferson Medical College; Assistant Physician, Philadelphia General Hospital. 1426 Spruce St.

1913. Jones, John F. X., B.S., A.B., A.M., M.D., Surgeon to St. Joseph's, Misericordia and St. Agnes' Hospitals. 1737 Chestnut St.

1900. Jopson, John H., M.D., Professor of Clinical Surgery, University of Pennsylvania; Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Presbyterian and the Children's Hospitals. 1824 Pine St.

1900. Judson, Charles F., A.B., M.D., Physician to Out-Patient Department of the Lankenau Hospital and to the Southern Home for Children. 1005 Spruce St.

1902. Jump, Henry D., M.D., Professor of Applied Therapeutics and Clinical Medicine, Woman's Medical College; Physician to Philadelphia General and Misericordia Hospitals. 2019 Walnut St.

1903. Kalteyer, Frederick J., M.D., Associate Professor of Medicine, Jefferson Medical College; Assistant Physician, Jefferson Medical College Hospital; Consulting Physician to the Pottstown Hospital, Pottstown, Pa. 1530 Locust St.

*1910. Karsner, Howard T., M.D., Professor of Pathology in the Western Reserve University Medical School. 2109 Adelbert Rd., Cleveland, Ohio.

1926. Kaufman, Isadore, M.D., Associate in Medicine, University of Pennsylvania; Medical Director, Kensington Dispensary for Tuberculosis; Associate Clinical and Sociological Director, Phipps Institute; Visiting Physician to White Haven Sanatorium. 316 Otis Building.

1923. Kay, James, M.D., Visiting Physician, Episcopal Hospital; Assistant Instructor of Medicine, Jefferson Medical College. 600 W. Olney Ave.

1920. Keating, Peter McCall, M.D., Chief of Surgical Dispensary, St. Agnes Hospital; Assistant Attending Surgeon, Bryn Mawr Hospital; Assistant, Surgical Out-Patient Department, Pennsylvania Hospital; Pathologist, Chester County Hospital. Medical Arts Building., San Antonio, Texas.

1924. Keeler, J. Clarence, M.D., Associate Professor of Otology, Jefferson Medical College and Hospital; Assistant in Otolaryngology, Germantown Hospital; Consultant Otolaryngologist, Pottstown Hospital, Pa., and Newcombe Hospital, Vineland, N. J. Medical Arts Building.

ELECTED

†1867. Keen, William W., M.D., LL.D. (Hon.), Ph.D. (Brown, Upsala, etc.), (Hon.) Sc.D. (Jefferson and Harvard), Dr., Honoris Causa, University of Paris; (Hon.) F.R.C.S. (Eng., Edin. and Ireland). 1520 Spruce St.

1912. Keene, Floyd E., M.D., Goodell Professor of Gynecology in the School of Medicine, and Professor of Gynecology in the Graduate School of Medicine, University of Pennsylvania; Gynecologist to the University Hospital; Gynecologist to the Chestnut Hill Hospital. 133 S. Thirty-sixth St.

1913. Kelly, Francis Joseph, M.D. 2211 Locust St.

*1887. Kelly, Howard A., A.B., M.D., LL.D. (Aberdeen, Wash. and Lee, and Univ. of Pa.), Professor of Gynecology in Johns Hopkins University and Gynecologist to the Johns Hopkins Hospital, Baltimore, Md.; Hon. Fellow of the Edinburgh Obstetrical Society, the Royal Academy of Medicine of Ireland, and of the Glasgow Obstetrical and Gynecological Society. 1418 Eutaw Place, Baltimore, Md.

1909. Kelly, James A., A.M., M.D., Visiting Surgeon to St. Mary's and Memorial Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania; Assisting Visiting Surgeon to St. Joseph's Hospital. 1900 S. Rittenhouse Square.

1912. Kelly, Thomas C., A.M., M.D., Associate in Medicine, University of Pennsylvania; Assistant Professor of Medicine, Graduate School, University of Pennsylvania; Pediatrist to St. Christopher, Misericordia and St. Mary's Hospitals; Assistant Physician, Philadelphia General Hospital. 105 School Lane, Germantown.

1898. Kempton, Augustus F., M.D. 2118 Pine St.

1905. Kercher, Delno E., M.D. 1534 Pine St.

1921. Kern, Richard A., A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Assistant Physician, University Hospital; Associate in Medicine, Graduate School of Medicine, University of Pennsylvania. 906 Medical Arts Building.

1920. Klauder, Joseph Victor, A.B., M.D., Professor of Dermatology, Woman's Medical College; Associate Professor, Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Dermatologist, Misericordia, Woman's Medical College and American Stomach Hospitals; Chief, Skin Clinic, Philadelphia General Hospital. 1934 Spruce St.

1920. Klein, Thomas, M.D., Associate Professor of Medicine, Graduate School of Medicine, University of Pennsylvania. 250 S. Eighteenth St.

ELECTED

1913. Klopp, Edward J., M.D., Associate in Surgery in the Jefferson Medical College; Assistant Surgeon to the Jefferson Hospital; Surgeon and Chief of the Out-Patient Clinic of the Pennsylvania Hospital; Surgeon to the Delaware County Hospital. 1611 Spruce St.

‡1895. Kneass, Samuel S., M.D., Associate in the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania. 1510 Walnut St.

1908. Knipe, Jay C., M.D., Ophthalmologist to the Jewish and Mary J. Drexel Hospitals; Associate in Ophthalmology, Jefferson Medical College; Chief of Eye Clinic, Jefferson Hospital. 1737 Chestnut St.

1919. Knipe, Norman Leslie, Ph.B. (Cornell); M.D., Gynecologist, St. Mary's Hospital; Associate Gynecologist, American Stomach Hospital. 2018 Chestnut St.

1908. Knowles, Frank Crozer, M.D., Professor of Dermatology, Jefferson Medical College; Dermatologist to the Presbyterian and Children's Hospitals; Chief of Clinic, Pennsylvania Hospital. 2035 Spruce St.

1925. Knox, Harry E., M.D., Instructor in Surgery, School of Medicine, University of Pennsylvania; Assistant Surgeon, Germantown, St. Christopher's and Episcopal Hospitals; Surgeon to Philadelphia Hospital for Contagious Diseases. 719 Sixty-sixth Ave., Oak Lane, Phila.

1914. Kolmer, John A., M.D., Dr. P.H., M.Sc., D.Sc., LL.D., Professor of Pathology and Bacteriology, Graduate School of Medicine, University of Pennsylvania; Head of the Department of Pathology and Bacteriology Research Institute for Cutaneous Medicine; Consulting Pathologist to St. Vincent's, Misericordia, Memorial and Jeanes Hospitals. Cynwyd, Pa.

1904. Krauss, Frederick, M.D., Ophthalmic Surgeon to the Episcopal Hospital; Ophthalmic Surgeon to St. Christopher's Hospital for Children; Laryngologist to the Abington Hospital. 1701 Chestnut St.

1914. Krumbhaar, Edward B., A.B., Ph.D., M.D., Professor of Pathology, School of Medicine, and Graduate School of Medicine, University of Pennsylvania. Box 4310, Chestnut Hill.

1900. Krusen, Wilmer, M.D., Professor of Gynecology in the Medical Department of Temple University; Chief Gynecologist to the Samaritan and the Garretson Hospitals; Consulting Gynecologist to the Charity and Mercy Hospitals. 127 N. Twentieth St.

ELECTED

1904. Landis, Henry R. M., M.D., Professor of Clinical Medicine in the School of Medicine, and Director of the Clinical and Sociological Departments of the Henry Phipps Institute of the University of Pennsylvania; Visiting Physician to the White Haven Sanatorium. 1817 Pine St.

1907. Langdon, H. Maxwell, M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor of Ophthalmology, School of Medicine, University of Pennsylvania; Ophthalmologist of the Presbyterian, Orthopedic and Children's Hospitals. 1530 Locust St.

1922. Lawrance, Stuart J., M.D., Obstetrician, St. Mary's Hospital. 1332 Spruce St.

1926. Laws, George M., B.S., M.D., Associate Gynecologist, Presbyterian Hospital; Gynecologist, American Hospital for Diseases of the Stomach. 1907 Spruce St.

1920. Leavitt, Frederick Headley, M.D., Associate in Neurology, Graduate School of Medicine, University of Pennsylvania; Assistant Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 1527 Pine St.

1904. Le Boutillier, Theodore, M.D., Assistant Professor, Epidemic Contagious Diseases, Graduate School of Medicine, University of Pennsylvania; Senior Pediatrist, Philadelphia Hospital for Contagious Diseases; Visiting Physician, Babies' Hospital, North Philadelphia. 2017 Spruce St.

1908. Lee, Walter Estell, M.D., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Pennsylvania, Germantown, Bryn Mawr and Children's Hospitals, and to the Hospital of the Graduate School of Medicine, University of Pennsylvania. 905 Pine St.

1903. Leffmann, Henry, A.M., M.D., D.D.S., Ph.D., Honorary Professor of Chemistry, Wagner Free Institute of Science; Emeritus Pathological Chemist, Jefferson Hospital; Lecturer on Research, Philadelphia College of Pharmacy and Science. 1729 N. Seventeenth St.

1892. Leidy, Joseph, M.D., Officier d'instruction publique, France; Consulting Physician to the Pennsylvania Training School for Feeble-minded Children. 1713 Walnut St.

1920. Leopold, Simon S., M.D., Associate in Medicine, University of Pennsylvania; Assistant Physician, University Hospital. 2025 Spruce St.

1915. Lewis, Fielding O., M.D., Associate in Laryngology in the Jefferson Medical College Hospital; Operating Clinical Chief of the Laryngological Dispensary and Clinical Assistant

ELECTED

of the Otological Dispensary of the Jefferson Medical College Hospital; Laryngologist of the Philadelphia General Hospital. 261 S. Seventeenth St.

‡1877. Lewis, Morris J., M.D., Attending Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases and Emeritus Physician to the Pennsylvania Hospital. Ambler, Pa.

*1911. Lewis, Paul A., M.D. Princeton, N. J.

1904. Lindauer, Eugene, M.D., Assistant Neurologist to the Philadelphia General and Polyclinic Hospitals; Instructor in Neurology, Graduate School of Medicine, University of Pennsylvania. 6451 N. Broad St.

1927. Lindsey, Walter H., A.B., M.D., Associate Physician, Episcopal Hospital; Associate in Cardiology, Graduate School of Medicine, University of Pennsylvania. S. E. Cor. Seventeenth and Arch Sts.

1886. Lloyd, J. Hendrie, A.M. (Princeton), M.D., Neurologist to the Methodist Episcopal Hospital; Consulting Neurologist to the State Asylum for the Chronic Insane at Wernersville, and to the Pennsylvania Training School for Feeble-minded Children at Elwyn. 4057 Spruce St.

1907. Lodholz, Edward, M.D., Isaac Ott Professor of Physiology, Graduate School of Medicine, University of Pennsylvania. Medical Laboratories, University of Pennsylvania.

1893. Longaker, Daniel, M.D., Consulting Obstetrician to the Kensington Hospital for Women. 1806 Spruce St.

1907. Loux, Hiram R., M.D., Professor of Genito-urinary Surgery in the Jefferson Medical College; Surgeon to the Philadelphia General Hospital. Medical Arts Building, Sixteenth and Walnut Sts.

1921. Lucké, Baldwin, Dr. P.H., M.D., Assistant Pathologist, University and Philadelphia General Hospitals; Associate Professor of Pathology, School of Medicine, and Assistant Professor of Pathology in the Graduate School of Medicine, University of Pennsylvania. Medical School, University of Pennsylvania.

1924. Ludy, John B., A.B., A.M., M.D., Dermatologist and Chief of Clinic, Pennsylvania Hospital; Dermatologist, Lankenau, Methodist and Delaware County Hospitals. Medical Arts Building.

1923. Lueders, Charles W., A.B., M.D., Gastroenterologist and Chief of Clinic, Pennsylvania Hospital; Consulting Biochemist, Pennsylvania Hospital for Mental and Nervous Diseases. Medical Arts Building.

ELECTED

1919. Lynch, Frank B., Jr., M.D., Dickson Fellow in Bacteriology to the Pepper Laboratory of Clinical Medicine, University of Pennsylvania; Serologist, University Hospital; Instructor in Pathology, Evans Institute, University of Pennsylvania. 6028 Columbia Ave.

1914. Lyon, B. B. Vincent, A.B. (Williams Coll.), M.D. (Johns Hopkins), Associate in Medicine, Jefferson Medical College; Chief-of-Clinic, Gastro-Intestinal Department, Jefferson Hospital. 328 S. Twenty-first St.

1900. McCarthy, Daniel J., M.D., Professor of Medical Jurisprudence (George B. Wood Foundation) in the University of Pennsylvania; Neurologist to the Philadelphia General and St. Agnes' Hospitals, and to the Henry Phipps Institute. 2025 Walnut St.

1913. McCrae, Thomas, B.A., M.D., F.R.C.P. (Lond.), Professor of Medicine in the Jefferson Medical College; Physician to the Jefferson and Pennsylvania Hospitals. 1929 Spruce Street.

1895. McFarland, Joseph, M.D., Sc.D., Professor of Pathology in the School of Medicine, University of Pennsylvania; Pathologist to the Philadelphia General Hospital. 442 W. Stafford St., Germantown.

1905. McKenzie, R. Tait, M.D., LL.D., Professor of Physical Education and Director of the Department of Physical Education in the University of Pennsylvania. 2014 Pine St.

*1916. McKnight, Howard A., A.B., M.D. Tecumseh Building, Springfield, Ohio.

1915. McLean, John D., M.D. 135 S. Thirty-sixth St.

1924. McMillan, Thomas M., A.B., M.D., Assistant Physician, Pennsylvania Hospital; Cardiologist, Philadelphia General Hospital; Instructor in Medicine, School of Medicine, University of Pennsylvania; Associate Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania. 2044 Locust St.

1924. McPhedran, F. Maurice, A.B., M.D., Associate in Medicine, School of Medicine, University of Pennsylvania; Assistant in Clinical Research, Henry Phipps Institute. Seventh and Lombard Sts.

*1900. McReynolds, Robert Phillips, M.D. 213 S. Broadway, Los Angeles, Calif.

1910. Mackinney, William H., M.D., Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Genito-

ELECTED

urinary Surgeon, Philadelphia General Hospital; Chief of Urologic Clinic, Lankenau Hospital. 1701 Chestnut St.

1901. MacLeod, George I., M.D. Ardmore, Pa.

1914. Maier, F. Hurst, M.D., Associate in Gynecology to the Jefferson Medical College; Gynecologist to St. Joseph's Hospital; Gynecologist, Obstetrician and Consultant, Prenatal Clinic, Philadelphia General Hospital; Associate Gynecologist, St. Mary's Hospital. 2019 Walnut St.

1913. Major, Charles P., B.S., M.D., Pediatrist to the Medical Service of the Germantown Hospital; Pediatrist to the Abington Memorial Hospital. Tenth and Oak Lane.

1913. Manges, Willis F., D.Sc., M.D., Roentgenologist to the Jefferson Hospital; Clinical Professor of Roentgenology, Jefferson Medical College. 235 S. Fifteenth St.

1898. Marshall, George Morley, M.D., Laryngologist to the Philadelphia General Hospital; Laryngologist and Otologist to St. Joseph's Hospital; Associate Professor of Laryngology in the Graduate School of Medicine, University of Pennsylvania. 1819 Spruce St.

1889. Martin, Edward, M.D., Emeritus Professor of Surgical Physiology, University of Pennsylvania. 135 S. Eighteenth St.

*1911. Meigs, Edward Browning, A.B., M.D., Physiologist in the Dairy Division of the United States Department of Agriculture. 1736 M. St., N. W., Washington, D. C.

1914. Mencke, J. Bernhard, A.B., M.D., Assistant Surgeon to the Lankenau Hospital; Surgeon to the Out-Patient Department of the Lankenau Hospital. 1816 Spruce St.

1923. Mendelson, Walter, M.D. 639 Church Lane, Germantown.

1914. Merrill, William Jackson, A.B., M.D., Associate Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Orthopedic Surgeon to the Children's Hospital, Germantown Hospital, Children's Seashore House; Consulting Orthopedic Surgeon to the Howard Hospital and Glen Mills School. 2017 Spruce St.

*1894. Miller, D. J. Milton, M.D., Associate Physician to the Children's Hospital, Philadelphia; Pediatrist to the Bamberger Home for Invalid Children, Longport, N. J. N. W. Cor. Pacific and California Aves., Atlantic City, N. J.

1922. Miller, Edwin B., M.D., Ophthalmologist to Stetson and Northwestern General Hospitals. 2008 Walnut St.

1921. Miller, T. Grier, A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Chief, Gastro-intestinal Clinic; Assistant Physician, University Hospital; Consultant, Friends'

ELECTED

Hospital and Shriners' Hospitals for Crippled Children. 110 S. Twentieth St.

1881. Mills, Charles K., M.D., LL.D., Emeritus Professor of Neurology in University of Pennsylvania; Neurologist to Philadelphia General Hospital; Consulting Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 2121 DeLancey St.

*1917. Mitchell, A. Graeme, M.D., Professor of Pediatrics, College of Medicine, University of Cincinnati; Director of Pediatric and Contagious Services, Cincinnati General Hospital; Chief of Staff of Children's Hospital, Cincinnati. Cincinnati General Hospital.

1904. Mitchell. Charles F., M.D., Surgeon to the Pennsylvania, Bryn Mawr, and Germantown Hospitals; Associate Professor of Surgery in the Graduate School of Medicine, University of Pennsylvania. 2003 Pine St.

1921. Mohler, Henry K., P.D., M.D., Associate in Medicine, Jefferson Medical College; Medical Director, Jefferson Hospital. 319 S. Sixteenth St.

*1908. Montgomery, Charles M., A.B., M.D. St. Joseph's Sanatorium, Asheville, N. C.

1928. Moon, Virgil Holland, A.B., M.D., M.Sc. Jefferson Medical College.

1923. Moore, William F., M.D., Assistant, Bronchoscopic Clinic, Jefferson Hospital; Bronchoscopist to Philadelphia General Hospital and Philadelphia Hospital for Contagious Diseases; Assistant Laryngologist, Children's Hospital, Out-Patient Department; Laryngologist to Tuberculosis Department, Philadelphia General Hospital. 255 S. Sixteenth St.

1924. Moorhead, Stirling W., A.B., M.D., Associate in Urology, School of Medicine, University of Pennsylvania; Assistant Surgeon, Department of Genito-urinary Surgery and in Urological Dispensary, University Hospital; Urologist, Howard Hospital. 1523 Pine St.

1918. Morgan, Arthur C., M.D., Professor of Applied Therapeutics, Medical Department, Temple University; Visiting Physician to Tuberculosis Department, Philadelphia General Hospital; Consulting Physician to the Eastern State Penitentiary and to the Frankford Hospital. 2018 Chestnut St.

1886. Morris, Caspar, M.D. 2050 Locust St.

1893. Morris, Elliston J., M.D., Consulting Physician to the Episcopal Hospital. 128 S. Eighteenth St.

ELECTED

‡1883. Morris, Henry, M.D., Emeritus Professor of Anatomy in the Woman's Medical College of Pennsylvania; Consulting Physician to St. Joseph's Hospital. 2310 Pine St.

1897. Morton, Samuel W., M.D. 2049 Chestnut St.

1905. Müller, George P., M.D., Professor of Clinical Surgery, University of Pennsylvania; Surgeon to the University and Misericordia Hospitals. 1930 Spruce St.

*1915. Musser, John H., Jr., B.S., M.D., Professor of Medicine and Head of Department, School of Medicine, Tulane University of Louisiana. 1551 Canal St., New Orleans, La.

1905. Mutschler, Louis H., M.D., Surgeon to the Episcopal Hospital; Associate Surgeon to the Orthopædic Hospital. 1625 Spruce Street.

*1896. Myers, T. D., M.D. 831 University Ave., Palto Alto, Calif.

1902. Nassau, Charles F., M.D., LL.D., Associate Professor of Surgery in the Jefferson Medical College; Surgeon to St. Joseph's Hospital; Chief Surgeon to the Frankford Hospital; Surgeon to Girard College. 1710 Locust St.

1886. Neff, Joseph S., A.M., M.D., LL.D., D.P.H., Narberth, Pa.

1887. Neilson, Thomas Rundle, A.M., M.D., Surgeon Emeritus to the Episcopal Hospital; Consulting Surgeon to St. Christopher's Hospital for Children; Emeritus Professor of Genito-urinary Surgery in the University of Pennsylvania. 1937 Chestnut St.

1905. Newcomet, William S., M.D., Physician in Charge of Radiological Department, Jefferson, Presbyterian and Oncologic Hospitals. 3501 Baring St.

1905. Newlin, Arthur, B.S., M.D., Physician to the Pennsylvania Hospital. 1804 Pine St.

1899. Nicholson, William Rufus, A.B., M.D., Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Attending Gynecologist and Attending Obstetrician to the Methodist Episcopal Hospital; Attending Obstetrician to the Presbyterian Hospital. 2023 Spruce St.

1889. Noble, Charles P., M.D., Sc.D. (Hon.), Formerly Surgeon-in-Chief, Kensington Hospital for Women; Formerly Clinical Professor of Gynecology, Woman's Medical College. Radnor, Pa.

1905. Norris, Charles C., M.D., Director of the Department and Professor of Obstetrics and Gynecology in the School of Medicine, and Professor of Gynecology in the Graduate School of Medicine, University of Pennsylvania; Gynecologist to the Radiological Department, Philadelphia General Hospital;

ELECTED

Consultant Gynecologist to Henry Phipps Institute and Maternity Hospital; Gynecologist to the Children's Hospital. 133 S. Thirty-sixth St.

1905. Norris, George William, A.B., M.D., Professor of Clinical Medicine in the University of Pennsylvania; Physician-in-Chief, Medical Service "A", Pennsylvania Hospital; Attending Specialist (Heart and Lungs), U. S. Public Health Service (Veterans' Bureau). 321 S. Eleventh St.

*1901. Norris, Henry, M.D., Surgeon to the Rutherford Hospital. Waverly Mills, S. C.

1892. Norris, Richard C., M.D., Professor of Obstetrics in the Graduate School of Medicine, University of Pennsylvania; Obstetrician in Charge of the Preston Retreat; Visiting Obstetrician to the Philadelphia General Hospital; Gynecologist to the Methodist Episcopal Hospital, and Consulting Obstetrician and Attending Gynecologist to the Southeastern Dispensary and Hospital. 500 N. Twentieth St.

1913. O'Neal, Alexander H., A.B., A.M., M.D., Physician to the Cathcart and Richardson Homes, Devon; Anesthetizer to the Bryn Mawr Hospital. St. Davids, Pa.

1924. Opie, Eugene L., A.B., M.D., Professor of Pathology and Director of the Department of Pathology in the School of Medicine, University of Pennsylvania; Director of Laboratories, Henry Phipps Institute. 2203 St. James Place.

1903. Ostheimer, Maurice, A.B., M.D., Whitford, Pa.

1913. Outerbridge, George W., A.B., M.D., Associate Professor of Gynecology, Graduate School of Medicine, University of Pennsylvania; Assistant Gynecologist to the Methodist Hospital; Gynecologist to the Abington Memorial Hospital. 1912 Spruce St.

1915. Owen, Hubley R., M.D., Professor of Clinical Surgery, Woman's Medical College; Surgeon, Philadelphia General Hospital; Assistant Surgeon, Orthopedic Hospital; Chief Surgeon, Bureaus of Police and Fire, Philadelphia. 319 S. Sixteenth St.

1897. Packard, Francis R., M.D., Chief of the Laryngological Service, Pennsylvania Hospital; Consulting Laryngologist Bryn Mawr Hospital; Otologist to the Children's Hospital of Philadelphia. 304 S. Nineteenth St.

1898. Page, Henry F., M.D., Assistant Physician to the Lankenau Hospital and Physician to the Medical Dispensary of the same; Clinical Professor of Medicine in the Woman's Medical College of Pennsylvania. 315 S. Sixteenth St.

ELECTED

1906. Pancoast, Henry K., M.D., Professor of Roentgenology in the School of Medicine, University of Pennsylvania and Roentgenologist to the University Hospital. Ardmore, Pa.

1909. Parish, Benjamin D., B.S., M.D., Associate Professor in Otology, Graduate School of Medicine, University of Pennsylvania; Aurist and Laryngologist to St. Agnes' and Chestnut Hill Hospitals. 1927 Spruce St.

1899. Parke, William E., M.D., Consulting Obstetrician to the Episcopal Hospital; Associate Surgeon to the Kensington Hospital for Women; Gynecologist to the Frankford Hospital. 1534 N. Fifteenth St.

1925. Patten, Clarence A., M.D., Assistant Professor of Neurology, Graduate School of Medicine, University of Pennsylvania; Consulting Neurologist, Shriner's Hospital for Crippled Children and Delaware County Hospital; Neurologist, Delaware General Hospital. 2037 DeLancey St.

1910. Patterson, Ross Vernet, M.D., Dean and Associate Professor of Medicine, Jefferson Medical College; Physician to the Philadelphia General Hospital; Physician to the Protestant Episcopal Hospital; Assistant Physician to the Jefferson Hospital. 2126 Spruce St.

1926. Paul, John Rodman, A.B., M.D., Director of the Ayer Clinical Laboratory of the Pennsylvania Hospital; Assistant Professor of Medicine, School of Medicine, Yale University; Associate Physician, New Haven Hospital and Dispensary. 146 Everitt St., New Haven, Conn.

1922. Pelouze, P. S., M.D., Associate in Urology, School of Medicine, University of Pennsylvania; Surgeon-in-Charge, Urological Dispensary, University Hospital. 1737 Chestnut St.

1909. Pemberton, Ralph, M.S., M.D., Visiting Physician and Director of the Department of Metabolic Diseases, Presbyterian Hospital; Associate Professor of Medicine, Graduate School, University of Pennsylvania. 2031 Locust St.

1914. Pepper, O. H. Perry, B.S., M.D., Professor of Clinical Medicine, School of Medicine, University of Pennsylvania. Medical Arts Building.

†1902. Pepper, William, A.B., M.D., Dean of the School of Medicine, University of Pennsylvania; Member of the Council on Medical Education and Hospitals of the American Medical Association. University of Pennsylvania.

1916. Percival, Milton Fraser, M.D. 2332 S. Broad St.

1917. Peter, Luther C., A.M., M.D., Professor of Diseases of the Eye, Temple Medical School; Professor of Ophthalmology,

ELECTED

Graduate School of Medicine, University of Pennsylvania. N. E. Cor. Twentieth and Chestnut Sts.

1912. Petty, Orlando H., B.S., A.M., M.D., Professor of Diseases of Metabolism, Graduate School of Medicine, University of Pennsylvania; Chief of the Department of Diseases of Metabolism, Hospitals of Graduate School of Medicine, University of Pennsylvania; Chief of Department of Metabolism, Philadelphia General Hospital. 1803 Pine St.

1905. Pfahler, George E., M.D., D.O.R.E. (Camb.), Professor of Radiology and Vice-Dean, Department of Radiology, Graduate School of Medicine, University of Pennsylvania; Director of Radiological Department, Misericordia Hospital. 1321 Spruce St.

1915. Pfeiffer, Damon B., A.B., M.D., Assistant Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon, Methodist and Abington Memorial Hospitals; Assistant Surgeon, Presbyterian and Lankenau Hospitals. 1822 Pine St.

1907. Pfromm, George W., Ph.G., M.D., Assistant Physician to the American Stomach Hospital; Consulting Physician to the German Protestant Home for the Aged. 1431 N. Fifteenth Street.

1907. Phillips, Horace, M.D., Assistant Surgeon, U. S. Public Health Service; Examining Physician, Office of the District Attorney. 905 Land Title Building.

1911. Piersol, George Morris, B.S., M.D., Professor of Medicine and Vice-Dean for Medicine, Graduate School of Medicine, University of Pennsylvania; Physician to the Philadelphia General and Methodist Episcopal Hospitals. 1913 Spruce Street.

1917. Piper, Edmund Brown, B.S., M.D., Professor of Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician to the University Hospital; Assistant Obstetrician and Gynecologist to the Philadelphia General Hospital. 1936 Spruce St.

1905. Pitfield, Robert L., M.D., Pathologist to the Germantown Hospital; Bacteriologist to the Chestnut Hill Hospital for Lung Diseases. 5211 Wayne Ave.

1922. Pleasants, Henry, Jr., A.B., M.D., Assistant Visiting Physician, Chester County Hospital, West Chester, Pa.; Assistant in Neurological Clinic, Orthopedic Hospital. West Chester, Pa.

1896. Posey, William Campbell, M.D., Consulting Ophthalmic Surgeon to Wills, Howard, Chestnut Hill and Abington Hospitals. Radnor, Pa.

ELECTED

1899. Potts, Charles S., M.D., Professor of Neurology, Graduate School of Medicine, University of Pennsylvania; Neurologist to the Philadelphia General Hospital; Consulting Neurologist, Lankenau Hospital; Consulting Neurologist, Hospital for the Insane, Atlantic County, New Jersey. 2018 Chestnut St.

*1907. Price, George E., M.D. Stinson Building, Seattle, Wash.

*1920. Quicksall, William E., M.D. E. 216 Fifteenth Ave., North, St. Petersburg, Fla.

1908. Radcliffe, McCluney, A.M. (Lafayette), M.D., LL.D., Consulting Ophthalmologist, Presbyterian Hospital; Attending Surgeon to the Wills Hospital. 1906 Chestnut St.

1913. Randall, Alexander, A.M., M.D., Associate Professor of Surgery in charge of the Department of Urology, School of Medicine, University of Pennsylvania. 1323 Medical Arts Building.

1887. Randall, B. Alex., M.A., M.D., Ph.D., Emeritus Professor of Otology in the School of Medicine, University of Pennsylvania; Ear Surgeon to the Children's Hospital; Consulting Aurist to the Pennsylvania Institution for the Dear and Dumb and to Memorial Hospital, Roxborough. 2320 DeLancey St.

1926. Ravdin, I. S., B.S., M.D., J. William White Assistant Professor of Surgical Research in the School of Medicine and Assistant Professor of Research Surgery in the Graduate School of Medicine, University of Pennsylvania; Assistant Surgeon, University Hospital. 4623 Larchwood Ave.

*1904. Ravenel, Mazyck P., M.D., Professor of Preventive Medicine and Bacteriology and Director of the Public Health Laboratory at the University of Missouri. 203 Hicks Avenue, Columbia, Mo.

1928. Reese, Warren S., M.D., Assistant Ophthalmologist, Pennsylvania Hospital; Assistant Surgeon, Wills Hospital; Associate Ophthalmologist, Delaware County Hospital; Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania. 230 S. Twenty-first St.

1925. Reeves, Rufus S., B.S., M.D. 2227 Spruce St.

1920. Rehfuss, Martin E., M.D. N. E. Cor. Sixteenth and Spruce Streets.

1921. Reiff, E. Paul, A.B., M.D., Member of Medical Staff, Methodist Episcopal Hospital. 5051 Chestnut St.

1919. Reimann, Stanley P., M.D., Director of the Research Institute, Lankenau Hospital; Assistant Professor of Experimental

ELECTED

Pathology, Graduate School of Medicine, University of Pennsylvania. 516 Arbutus St., Germantown.

1923. Repplier, Sidney, J., M.D., Medical Director, Curtis Hospital, Curtis Publishing Company. Chestnut Hill, Phila.

1906. Rhein, Robert D., M.D., Chief Physician to the Clinic of the American Hospital for Diseases of the Stomach; Physician to the Philadelphia Home for Incurables; Examining Physician to the White Haven Sanatorium. S. W. Cor. Fifteenth and Pine Sts.

*1910. Rhoads, Samuel, M.D. Altadena, Calif.

1919. Richardson, Russell, A.M., M.D., Director of the Laboratory, Methodist Episcopal Hospital; Pathologist to Abington Memorial Hospital and the Associated Medical Clinics; Instructor in Medicine, University of Pennsylvania. 320 S. Sixteenth St.

1919. Ridpath, Robert F., M.D., Professor of Rhino-laryngology, Temple University; Associate Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania; Laryngologist, Samaritan and Jewish Hospitals. 1737 Chestnut St.

1898. Riesman, David, M.D., Professor of Clinical Medicine, School of Medicine, University of Pennsylvania; Visiting Physician to the Philadelphia General and University Hospitals; Consulting Physician to the Jewish and Woman's Hospitals. 1520 Spruce St.

1895. Ring, G. Oram, A.M., M.D., Consulting Ophthalmologist to the Episcopal Hospital; Ophthalmologist to the Widener Memorial Home for Crippled Children; Consulting Ophthalmologist to the American Oncologic Hospital. N. E. Cor. Seventeenth and Walnut Sts.

1899. Roberts, Walter, M.D., Professor of Otology in the Graduate School of Medicine, University of Pennsylvania; Otologist to the Methodist Episcopal Hospital; Laryngologist to the Philadelphia General Hospital. 1921 Spruce St.

1903. Robertson, William Egbert, M.D., Professor of Theory and Practice of Medicine and of Clinical Medicine in Temple University; Physician to the Samaritan and Garretson Hospitals. 327 S. Seventeenth St.

1903. Robinson, William Duffield, Ph.G., M.D. 2012 Mount Vernon St.

1912. Rodman, John Stewart, M.D., Professor of Surgery, Woman's Medical College; Surgeon-in-Chief, Woman's College Hospital; Attending Surgeon, Bryn Mawr Hospital; Assistant Surgeon to the Presbyterian Hospital. 1310 Medical Arts Building.

ELECTED

1928. Rose, Edward, M.D., Instructor in Medicine, University of Pennsylvania; Medical Registrar, University Hospital. 1726 Pine St.

1909. Rosenberger, Randle C., M.D., Professor of Preventive Medicine and Bacteriology in the Jefferson Medical College. 1001 Walnut St.

*1907. Royer, B. Franklin, M.D. 370 Seventh Ave., New York City.

†1905. Rugh, James Torrance, A.B., M.D., Clinical Professor of Orthopedic Surgery in the Woman's Medical College of Pennsylvania; Orthopedic Surgeon to the Jefferson Medical College; Orthopedic Surgeon to the Methodist and the Philadelphia General Hospitals. 1616 Spruce St.

‡1897. Sailer, Joseph, Ph.B., M.D., Professor of Clinical Medicine in University of Pennsylvania; Physician to the Philadelphia General, the University, and Presbyterian Hospitals. 250 S. Eighteenth St.

1900. Sajous, Charles E. de M., M.D., LL.D., Sc.D., Officer of the Legion of Honor of France and of the Order of Leopold of Belgium; Professor of Applied Endocrinology, Graduate School of Medicine, University of Pennsylvania; Emeritus Professor of Therapeutics in Temple University Medical School. 2043 Walnut St.

1905. Sartain, Paul J., A.M., M.D. 2006 Walnut St.

1908. Sautter, Albert C., M.D., Assistant in the Eye Dispensary of the Lankenau Hospital. 5909 Greene St., Germantown.

1927. Saxon, Gordon J., M.D. 1506 Medical Arts Building.

1906. Saylor, Edwin S., M.D., Chief Ophthalmologist to the Diagnostic Hospital of Philadelphia. 1737 Chestnut St.

1920. Scarlett, Hunter W., M.D., Associate in Ophthalmology in the Graduate School of Medicine, and Medical Examiner in the Department of Physical Education, University of Pennsylvania. 230 S. Twenty-first St.

1917. Schaeffer, Jacob Parsons, A.M., M.D., Ph.D., Sc.D., Professor of Anatomy and Director of the Daniel Baugh Institute of Anatomy of the Jefferson Medical College. 4634 Spruce St.

1899. Schamberg, Jay F., M.D., Professor of Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania; Director, Research Institute of Cutaneous Medicine. 1402 Spruce St.

ELECTED

1917. Schnabel, Truman Gross, A.B. (Lehigh), M.D., Associate in Medicine, University of Pennsylvania; Physician, Philadelphia General and Howard Hospitals, and Medical Dispensary University Hospital. 1704 Pine St.

1917. Schoff, Charles H., M.D. Media, Pa.

1928. Schofield, Frederick S., A.B., M.D., Associate in Urology, Medical School, University of Pennsylvania; Chief of Urological Dispensary, University Hospital; Urologist, Orthopedic Hospital; Assistant Urologist, Chestnut Hill Hospital. 822 Medical Arts Building.

1921. Schumann, Edward Armin, A.B., M.D., Assistant Professor of Obstetrics, School of Medicine, University of Pennsylvania; Obstetrician and Gynecologist, Philadelphia General Hospital; Gynecologist, Frankford Hospital; Lecturer on Obstetrics, Jefferson Medical College; Consulting Gynecologist, Rush Hospital. 1814 Spruce St.

1887. de Schweinitz, George Edmund, A.M., M.D., LL.D., L.H.D., Sc.D., Professor of Ophthalmology in the Graduate School of Medicine, University of Pennsylvania; Consulting Ophthalmic Surgeon to the Orthopedic, Philadelphia General and Bryn Mawr Hospitals. 1705 Walnut St.

*1913. de Schweinitz, George Lord, B.S., M.D., Assistant in the Department of Ophthalmology, St. Luke's Hospital, Bethlehem, Pa. 85 East Broad St., Bethlehem, Pa.

1910. Schwenk, Peter N. K., M.A., M.D., Attending Surgeon to Eye Department of the Pennsylvania Hospital; Attending Surgeon to the Wills Hospital. 1417 N. Broad St.

1917. Service, Charles A., M.D. Bala, Pa.

1924. Shallow, Thomas A., M.D., Assistant Surgeon, Jefferson Hospital; Demonstrator of Clinical Surgery, Jefferson Medical College; Surgeon to the Philadelphia General Hospital. 3942 Chestnut St.

1908. Shannon, Charles E. G., A.B., M.D., Instructor in Ophthalmology in the Jefferson Medical College; Assistant in the Ophthalmological Clinic at the Jefferson Medical College Hospital; Ophthalmologist to the Seybert Institution. N. E. Corner Seventeenth and Walnut Sts.

1928. Sharpe, John Semple, M.D. Haverford, Pa.

1928. Sharpless, Frederick Cope, A.B., M.D., Attending Physician, Bryn Mawr, Hospital. Rosemont, Pa.

1897. Sharpless, William T., M.D., Physician to the Chester County Hospital. West Chester, Pa.

ELECTED

1906. Shields, William G., M.D., Dermatologist to Germantown Hospital; Chief of Dermatological Clinic and Assistant Physician to the Jewish Hospital. 414 School Lane, Germantown.

*1908. Shoemaker, Harlan, A.B., M.D., Chief Surgeon to Los Angeles County Hospital; Chief of the Surgical Staff of the Methodist Hospital and of the Hospital of the Good Samaritan. 521 Bank of Italy Building, Los Angeles, Calif.

†1893 Shoemaker, Harvey, M.D., Visiting Physician to the Sheltering Arms; Consulting Physician to the Southern Home for Destitute Children; Assistant Physician to the Lankenau Hospital; Physician to the Out-Patient Department of the Lankenau Hospital. 1727 Spruce St.

†1896. Shoemaker, William T., M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Clinical Professor of Ophthalmology in the Woman's Medical College of Pennsylvania; Ophthalmic Surgeon to Lankenau, Germantown and Pennsylvania Hospitals. 2017 Locust St.

1900. Shumway, Edward Adams, B.S., M.D., Ophthalmic Surgeon to the Lankenau, Children's and Oncologic Hospitals. 1737 Chestnut St.

1903. Sinclair, John Falconer, M.D., Epidemiologist, Presbyterian Hospital; Physician to the Philadelphia Orphan Asylum and to the Presbyterian Orphanage; Physician to the Home of the Merciful Saviour for Crippled Children. 4103 Walnut St.

1907. Sinkler, Francis Wharton, A.B., M.D., Physician to the Orthopedic Hospital and Infirmary for Nervous Diseases. 1226 Medical Arts Building.

1902. Siter, E. Hollingsworth, M.D., Genito-urinary Surgeon to the Philadelphia General Hospital. 2213 DeLancey St.

1920. Skillern, Ross Hall, M.D., Sc.D., Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 1811 Spruce St.

1928. Skillern, Samuel Ruff, M.D., Assistant Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 1734 Pine St.

1905. Smith, S. MacCuen, M.D., Professor of Otology in the Jefferson Medical College; Aurist and Laryngologist to the Germantown Hospital; Aurist to the Jewish Hospital; Consulting Aurist to the Memorial Hospital, Roxborough, and to the Oncologic Hospital. 1429 Spruce St.

ELECTED

1927. Smyth, Calvin M., Jr., M.D., Associate in Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Attending Surgeon to the Methodist and Abington Hospitals. 257 S. Twenty-first St.

1919. Smyth, Henry Field, M.D., Assistant Professor of Industrial Hygiene, School of Hygiene, University of Pennsylvania. Wayne, Pa.

1928. Spaeth, Edmund B., M.D., Associate in Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Instructor in Ophthalmology, School of Medicine, Temple University. N. E. Cor. Twentieth and Chestnut Sts.

1908. Speese, John, M.D., Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Surgeon to the Children's and Presbyterian Hospitals. 1832 Spruce St.

1897. Spiller, William G., M.D., Professor of Neurology in the University of Pennsylvania; Consulting Neurologist to the Philadelphia General Hospital. 4409 Pine St.

1894. Stahl, B. Franklin, B.S., Ph.G., M.D. Consulting Surgeon to St. Agnes' Hospital. Haverford, Pa.

1909. Starbuck, J. Clinton, M.D., Physician to the Orphanage, Orphan Society of Philadelphia, at Wallingford, and to the Glen Mills School, Glen Mills, Pa. 42 E. Washington St., Media, Pa.

1927. Starr, Isaac, Jr., B.S., M.D., Assistant Professor of Clinical Pharmacology and Associate in Medicine, School of Medicine, University of Pennsylvania; Acting Physician, University Hospital. Chestnut Hill.

1912. Stauffer, Nathan Pennypacker, D.D.S., M.D., Laryngologist and Otologist to the Presbyterian Hospital; to the Philadelphia General Hospital, Tubercular Department; to the Home for Crippled Children. 1900 Rittenhouse Square.

1910. Stellwagen, Thomas C., Jr., M.D., Chief Clinical Assistant in the Out-Patient Surgical Department of the Jefferson Medical College Hospital. 220 S. Sixteenth St.

1895. Stengel, Alfred, M.D., Sc.D., Professor of Medicine in the University of Pennsylvania; Physician to the University Hospital and the Pennsylvania Hospital. 1728 Spruce St.

1901. Stevens, Arthur A., M.D., Professor of Applied Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Therapeutics and Clinical Medicine in the Woman's Medical College of Pennsylvania; Physician to St. Agnes' Hospital. 314 S. Sixteenth St.

1914. Stewart, Thomas S., B.S. (Univ. of Penna.), M.D. 1532 Pine St.

ELECTED

1925. Stokes, John H., A.B., M.D., Professor of Dermatology and Syphilology, School of Medicine, and Graduate School of Medicine, University of Pennsylvania; Attending Dermatologist, University and Philadelphia General Hospitals; Dermatologist, Hospital of the Graduate School of Medicine. 3800 Chestnut St.

1928. Stokes, Joseph, Jr., A.B., M.D., Associate in Pediatrics, School of Medicine, University of Pennsylvania. 159 W. Coulter St., Germantown.

1898. Stout, George C., M.D., Consulting Laryngologist and Aurist to the Presbyterian Hospital, the Children's Aid Society and the William Penn Charter School. 2015 Walnut St.

1923. Strecker, Edward, A., A.M., M.D., Professor of Nervous and Mental Diseases, Jefferson Medical College; Clinical Professor of Psychiatry and Mental Hygiene, Yale University Medical School; Neurologist, Pennsylvania Hospital; Medical Director of Department for Mental and Nervous Diseases, Pennsylvania Hospital 4401 Market St.

1923. Stroud, William D., B.S., M.D., Physician to the Pennsylvania Hospital and Chief of Out-Patient and Heart Clinics; Associate Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania; Associate in Medicine, School of Medicine, University of Pennsylvania; Physician in Charge of the Children's Heart Hospital, Wynnefield, Pa. 1011 Clinton St.

1923. Strouse, Frederick M., M.D., Assistant Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. 1301 Spruce St.

1884. Stryker, Samuel S., M.D., Consulting Physician to the Presbyterian Hospital. 3833 Walnut St.

1927. Sturgis, Samuel B., M.D. Ardmore, Pa.

*1900. Swan, John M., M.D., Attending Physician, Park Avenue Hospital. 457 Park Avenue, Rochester, N. Y.

1928. Swartley, William B., M.D., Surgeon to Germantown Dispensary and Hospital and to Chestnut Hill Hospital; Instructor in Anatomy, Jefferson Medical College. 6002 Greene St., Germantown.

1900. Talley, James Ely, A.B., M.D., Professor of Cardiology, Graduate School of Medicine, University of Pennsylvania; Physician to the Presbyterian Hospital. 1811 Spruce St.

1886. Taylor, John Madison, A.B., and A.M. (Princeton), M.D., Professor of Physical Therapeutics and Dietetics, Medical Department, Temple University. 1504 Pine St.

ELECTED

1887. Taylor, William J., M.D., Surgeon to the Orthopedic Hospital and Infirmary for Nervous Diseases; Consulting Surgeon to St. Agnes', West Philadelphia Hospital for Women and Woman's Hospitals. 1825 Pine St.

1886. Taylor, William L., M.D. 2223 Tioga St.

†1910. Thomas, Benjamin A., A.B., A.M., M.D., Vice-Dean and Professor of Urology, Graduate School of Medicine, University of Pennsylvania; Genito-urinary Surgeon, Presbyterian Hospital; Consulting Genito-urinary Surgeon, Pennsylvania Railroad and to the County Prison, Philadelphia. 1900 Spruce St.

‡1912. Thomas, Frank Wister, A.M., M.D., Visiting Physician to "Buttercup Cottage;" Consulting Physician to the Germantown Hospital. 27 E. Mt. Airy Ave.

1928. Thomas, J. Earl, M.D. Drexel Hill, Pa.

1907. Thomas, Thomas Turner, M.D., Associate Professor of Applied Anatomy and Associate in Surgery in the University of Pennsylvania; Surgeon to the Philadelphia General Hospital; Assistant Surgeon to the University Hospital. 1737 Chestnut Street.

1896. Thorington, James, A.M., M.D., Consulting Ophthalmic Surgeon to the Presbyterian Hospital; Ophthalmologist to the Ellwyn, Pa., Training School for Feeble-minded Children. 2031 Chestnut St.

1927. Thorington, J. Monroe, B.S., A.M., M.D., Instructor in Ophthalmology, University of Pennsylvania; Assistant in Ophthalmology, Presbyterian Hospital. 2031 Chestnut St.

1898. Thornton, Edward Q., M.D., Assistant Professor of Materia Medica in the Jefferson Medical College. 1331 Pine St.

1912. Torrey, Robert G., M.D., Physician to the Philadelphia General Hospital; Associate Professor of Medicine, Graduate School of Medicine, and Associate in Medicine, School of Medicine, University of Pennsylvania. 1716 Locust St.

1896. Toulmin, Harry, M.D., Vice-President, Medical Department, Penn Mutual Life Insurance Company. Haverford, Pa.

1908. Tracy, Stephen E., M.D., Gynecologist to the Stetson Hospital; Visiting Surgeon to the Gynecean Hospital. 1737 Chestnut St.

1926. Tucker, Gabriel, M.D., Associate Professor of Bronchoscopy and Esophagoscopy, Graduate School of Medicine, and Associate Bronchoscopic Surgeon, University Hospital, University of Pennsylvania; Associate in Bronchoscopy and Assistant

ELECTED

Bronchoscopist, Jefferson Medical College and Hospital; Bronchoscopist, Misericordia and Bryn Mawr Hospitals. Cynwyd, Pa.

*1901. Tucker, Henry, M.D. Bellevue, Md.

†1894. Tunis, Joseph Price, M.D., Assistant Professor of Histology and Embryology, Temple University. Chestnut Hill, Philadelphia.

1924. Turner, Charles Root, A.B., D.D.S., M.D., Dean, School of Dentistry, University of Pennsylvania. Merion, Pa.

1923. Turner, Creighton H., M.D., Associate in Medicine, Jefferson Medical College; Visiting Physician, St. Agnes' Hospital. 1731 Pine St.

‡1897. Tyson, T. Mellor, M.D., Physician to the Philadelphia General Hospital; Physician to the Rush Hospital, the Philadelphia Lying-in-Charity Hospital and the Children's Aid Society of Philadelphia. 1506 Spruce St.

1907. Ullom, Josephus Tucker, M.A., M.D., Physician to the Chestnut Hill Hospital. Carpenter and Quincy Streets, Germantown.

*1913. Vail, William Penn, B.S., M.S., M.D., Laryngologist to the Pennsylvania Institution for the Instruction of the Blind; Laryngologist to the Department for Tuberculosis of the Philadelphia General Hospital; Assistant Laryngologist and Otologist to the Out-Patient Department of the Pennsylvania Hospital; Assistant Laryngologist to the Children's Hospital. Blairstown, N. J.

1873. Van Harlingen, Arthur, Ph.B. (Yale), M.D., Emeritus Professor of Diseases of the Skin in the Philadelphia Polyclinic. Bryn Mawr, Pa.

1903. Van Pelt, William Turner, M.D. Chestnut Hill, Philadelphia.

‡1893. Vansant, Eugene Larue, M.D. 1737 Chestnut St.

1912. Vaux, Norris Wistar, M.D., Clinical Professor of Obstetrics, Jefferson Medical College; Chief of Maternity Service, Philadelphia Lying-in and Pennsylvania Hospitals; Surgeon to the Chestnut Hill Hospital; Surgeon to the Dispensary of the Germantown Hospital. 2031 Locust St.

*1897. Veasey, Clarence A., A.M., M.D., Ophthalmic Surgeon to the Deaconess and to St. Luke's Hospitals. Suite 404, Paulsen Building, Spokane, Wash.

†1883. Vinton, Charles Harrod, A.M., M.D. P. O. Box 464, Atlantic City, N. J.

ELECTED

1903. Wadsworth, William Scott, M.D. 3914 Baltimore Ave.

1927. Wagers, Arthur J., M.D., Assistant Professor of Laryngology Graduate School of Medicine; University of Pennsylvania; Demonstrator of Otology and Instructor in Laryngology, Jefferson Medical College; Otologist, Joseph Price Hospital. The Lenox, Thirteenth and Spruce Sts.

1928. Wagoner, George W., M.D., Associate in Pathology, School of Medicine, and Associate in Orthopedic Surgery, Graduate School of Medicine, University of Pennsylvania; Clinical Surgeon, Orthopedic Hospital; Attending Orthopedist, Bryn Mawr Hospital. 2008 Walnut St.

1906. Walker, John K., M.D., Physician to the Children's Hospital of the Mary J. Drexel Home; Physician to the Out-Patient Department of the Pennsylvania Hospital. 1814 Pine St.

1907. Walker, Warren, M.D., Dermatologist to the Episcopal and Bryn Mawr Hospitals. 1819 Chestnut St.

1904. Walsh, Joseph, A.M., M.D., Visiting Physician to and Medical Director of the White Haven Sanatorium. Medical Arts Building.

1895. Watson, Arthur W., M.D., Professor of Diseases of the Throat and Nose in the Philadelphia Polyclinic and College for Graduates in Medicine; Laryngologist to the Jewish Hospital; Laryngologist and Aurist to the Mt. Sinai Hospital; Laryngologist to Home for Incurables. 2013 Locust St.

1923. Watson, William R., M.D., Chief Laryngologist, Episcopal and Diagnostic Hospitals; Assistant Chief Laryngologist, Pennsylvania Hospital. 2124 Pine St.

1903. Weber, Charles H., M.D., Assistant Professor of Pediatrics, Graduate School of Medicine, University of Pennsylvania; Consulting Physician to the Medical Dispensary, Children's Hospital; Pediatrist, Howard Hospital and to the Municipal Court. 2048 Pine St.

1920. Weidman, Fred. D., M.D., Professor of Dermatological Research, University of Pennsylvania; Assistant Pathologist, Philadelphia Zoölogical Garden; Attending Dermatologist, Philadelphia General Hospital. 20 Tenby Road, Llanerch, Pa.

1906. Weisenburg, Theodore H., M.D., Professor of Neuro-Psychiatry, Graduate School of Medicine, University of Pennsylvania; Neurologist, Philadelphia General Hospital, and Physician to Orthopedic Hospital and Infirmary for Nervous Diseases. 2037 DeLancey St.

1923. Weiss, Edward, M.D., Physician to the Tuberculosis Wards, Philadelphia General Hospital; Associate in Pathology, Jefferson Medical College. 1923 Spruce St.

ELECTED

1913. Wells, P. Frailey, A.M., M.D., Ph.D. 754 N. Fortieth St.

1893. Westcott, Thompson S., M.D., Consulting Pediatrist to the Methodist Episcopal Hospital; Consulting Pediatrist, Haddock Memorial Home. 1720 Pine St.

1921. Whitaker, William, M.D. 5448 Germantown Ave.

1901. White, Courtland Y., M.D., Director of the Pathological Laboratories of the Episcopal Hospital; Pathologist to the Children's Hospital and to the Kensington Hospital for Women; Chief Bacteriologist to the Bureau of Health, Department of Health and Charities, Philadelphia; Associate Professor of Bacteriology in the Graduate School of Medicine, University of Pennsylvania. 6611 N. Tenth St.

*1905. Whiteway, Harold M., M.D. 2356 W. Twenty-first St., Los Angeles, Calif.

1898. Whiting, Albert D., M.D., Associate Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Associate Surgeon, Lankenau Hospital; Surgeon, Germantown Hospital. 333 S. Eighteenth St.

1925. Widmann, Bernard P., M.D., Assistant Professor of Radiology, Graduate School of Medicine, University of Pennsylvania; Chief of the Radiological Department of the Philadelphia General Hospital. 250 S. Eighteenth St.

1914. Willard, de Forest P., B.S. (Univ. of Penna.), M.D., Professor of Orthopedics, Graduate School of Medicine, University of Pennsylvania; Orthopedic Surgeon to the Graduate and Delaware Hospitals and Consultant to the Shriners' Hospital for Crippled Children. 1729 Spruce St.

1907. Williams, Carl, B.S., M.D., Ophthalmic Surgeon to the Germantown Hospital; Instructor in Ophthalmology in the University of Pennsylvania; Ophthalmic Surgeon to the Pennsylvania Institution for the Deaf and Dumb. School Lane and Greene Sts., Germantown.

1924. Williams, Horace James, M.D., Instructor in Otolaryngology, School of Medicine, University of Pennsylvania. 5908 Greene St., Germantown.

1920. Williams, Philip F., Ph.B., M.D., Assistant Professor of Obstetrics, Graduate School of Medicine, University of Pennsylvania; Associate in Obstetrics, School of Medicine, University of Pennsylvania; Gynecologist and Obstetrician to Philadelphia and Jewish Hospitals; Obstetrician, Abington Memorial Hospital. 2206 Locust St.

1927. Williamson, Ernest G., M.D., Surgeon, Children's Hospital; Assistant House Surgeon, Pennsylvania Hospital; Assistant

ELECTED

Surgeon, Presbyterian and Jefferson (Dispensary) Hospitals. 6353 Woodbine Ave.

1916. Wilmer, Harry B., M.D., Assistant Professor of Clinical Allergy in the Graduate School of Medicine, University of Pennsylvania; Visiting Physician to the Germantown Hospital; Associate Physician, Presbyterian Hospital; Director of the Allergic Clinic, Germantown and Presbyterian Hospitals. 138 W. Walnut Lane, Germantown.

1921. Wilson, George, M.D., Assistant Professor of Neurology, School of Medicine, University of Pennsylvania; Clinical Professor of Neurology, Women's Medical College of Pennsylvania; Neurologist, Philadelphia General, Episcopal and Abington Memorial Hospitals; Assistant Neurologist, University Hospital. 133 S. Thirty-sixth St.

1874. Wilson, James Cornelius, A.M. (Princeton), M.D., Emeritus Professor of the Practice of Medicine and of Clinical Medicine in the Jefferson Medical College; Physician-in-Chief (Emeritus) to the Lankenau Hospital; Emeritus Physician to the Pennsylvania Hospital; Consulting Physician to the Bryn Mawr Hospital. 1509 Walnut St.

1902. Wilson, Samuel M., M.D. 2018 Chestnut St.

1897. Wilson, W. Reynolds, M.D. Villa Nova, Pa.

1904. Wister, James W., M.D., Physician to the Out-Patient Department of the Germantown Hospital. 5430 Germantown Ave.

*1901. Witmer, A. Ferree, M.D. 21 North Grand Ave., Baldwin, N. Y.

1918. Wolferth, Charles Christian, A.B., M.D., Assistant Professor of Medicine, University of Pennsylvania; Director of the Clinic for Diseases of the Heart and Bloodvessels, Robinette Foundation, University Hospital; Consulting Cardiologist, Jewish Hospital. 1704 Pine St.

1893. Wood, Alfred C., M.D., Assistant Professor of Surgery in the University of Pennsylvania; Surgeon to the University, the Philadelphia General, St. Timothy's and the Howard Hospitals. 2035 Walnut St.

1900. Wood, George, B., M.D., Laryngologist and Otologist, Orthopedic and Howard Hospitals; Professor of Laryngology, Graduate School of Medicine, University of Pennsylvania. N. E. Cor. Twentieth and Chestnut Sts.

1903. Wood, Horatio C., Jr., M.D., Professor of Pharmacology and Therapeutics in the University of Pennsylvania; Professor of Materia Medica, Philadelphia College of Pharmacy and Science. 319 S. Forty-first St.

ELECTED

*1911. Woods, Andrew H., A.B., M.D. 621 Summit St., Iowa City, Iowa.

†1897. Woodward, George, M.D. W. Willow Grove Ave., Chestnut Hill, Philadelphia.

1903. Worden, Charles B., A.M., M.D. Princeton, N. J.

1928. Wright, Carroll S., B.Sc., M.D., Associate Professor of Dermatology-Syphilology, Graduate School of Medicine, University of Pennsylvania; Attending Dermatologist, Philadelphia General Hospital. 1402 Spruce St.

1894. Zentmayer, William, M.D., Professor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania; Consulting Surgeon to the Wills Hospital; Consulting Ophthalmologist to the Glen Mills School and to St. Mary's Hospital. 1506 Spruce St.

1887. Ziegler, Walter M.L., A.M., M.D. 1418 N. Seventeenth St.

1895. Zimmerman, Mason W., M.D., Consulting Ophthalmic Surgeon to the Germantown Hospital. 1518 Waverly St.

ASSOCIATE FELLOWS

(Limited to Fifty, of whom Twenty may be Foreigners)

American

ELECTED

‡1911. Abbe, Robert, M.D. 40 W. Fifty-ninth St., New York City, New York.

1909. Billings, Frank, M.D., 1550 North State Parkway, Chicago, Illinois.

1880. Carrow, Flemming, M.D., 823 David Whitney Building, Detroit, Mich.

1893. Councilman, William T., M.D., Harvard Medical College, Boston, Massachusetts.

1909. Crile, George W., M.D., 1021 Prospect Avenue, S. E., Cleveland, Ohio.

1909. Dana, Charles Loomis, M.D., 53 West Fifty-third Street, New York City, New York.

1892. Emmet, Thomas Addis, M.D., 91 Madison Avenue, New York City, New York.

1916. Estes, William Lawrence, M.D., South Bethlehem, Pa.

1912. McCaw, Brig.-Gen. Walter D., M.D. Assistant Surgeon-General, U. S. A., Army Medical School, Washington, D. C.

1906. Mayo, William J., M.D., Rochester, Minnesota.

1917. Miner, Charles H., M.D., Wilkes-Barre, Pa.

1906. Pilcher, Lewis Stephen, M.D., 489 Washington Avenue, Brooklyn, New York.

1906. Shattuck, Frederick C., M.D., 135 Marlborough Street, Boston, Massachusetts.

1892. Welch, William H., M.D., Johns Hopkins Hospital, Baltimore, Maryland.

Foreign

ELECTED

1928. Archibald, Edward, M.D., McGill University, Montreal, Canada.

1924. Hopkins, Sir F. Gowland, M.D., Biochemical Department, University of Cambridge, Cambridge, England.

1909. Macallum, Archibald B., M.A., M.B., Ph.D., Sc.D., LL.D., F.R.S., Department of Biochemistry, McGill University, Montreal, Canada.

1922. McCarrison, Colonel Robert, M.D., C.I.E., D.Sc. LL.D., F.R.C.P. (London), Honorary Physician to the King. Pasteur Institute, Coonoor, S. India.

1924. Macleod, John James R., M.D., M.B., D.Sc. (Hon.), LL.D., F.R.S., 43 Nanton Ave., Toronto, Canada.

1906. Myles, Sir Thomas, M.D., 33 Merion Square, W. Dublin, Ireland.

1885. Rendu, Jean, M.D., Lyons, France.

1928. Rolleston, Sir Humphry, Bart., K.C.B., D.C.L. (Durh.), LL.D., M.D., "Southfield," Trumpington Road, Cambridge, England.

1908. Ross, Col. Sir Ronald, K.C.B., K.C.M.G., F.R.S., M.D., D.Sc., LL.D., Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S. W. 15, England.

NECROLOGICAL LIST

FELLOWS

FRANK W. THOMAS, M.D.	January	19, 1928
EUGENE L. VANSANT, M.D.	February	15, 1928
HORACE CARNCROSS, M.D.	March	4, 1928
ROBERT ABBE, M.D.	March	7, 1928
MORRIS J. LEWIS, M.D.	April	16, 1928
ALFRED HEINEBERG, M.D.	May	13, 1928
WILLIAM M. L. COPLIN, M.D.	May	29, 1928
T. MELLOR TYSON, M.D.	November	27, 1928
SAMUEL S. KNEASS, M.D.	December	7, 1928
JOSEPH SAILER, M.D.	December	31, 1928
ROBERT F. WEIR, M.D.	April	6, 1927

LIST OF PRIZES AND LECTURES

THE WILLIAM F. JENKS MEMORIAL PRIZE

(Triennial)

1889	John Strahan, M.D.	Belfast (Ireland).
1895	Abram Brothers, M.D.	New York.

NOTE.—June 12, 1900, the William F. Jenks Memorial Prize Fund was transferred to the Library as the "William F. Jenks Memorial Library Fund."

ALVARENGA PRIZE OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

(Annual)

1890	R. W. Philip, M.D.	Edinburgh (Scotland).
1891	L. Duncan Bulkley, M.D.	New York.
1892	R. H. L. Bibb, M.D.	Saltillo.
1894	G. E. de Schweinitz, M.D.	Philadelphia.
1895	Guy Hinsdale, M.D.	Philadelphia.
1897	Joseph Collins, M.D.	New York.
1898	S. A. Knopf, M.D.	New York.
1898	Robert Randolph, M.D.	Baltimore.
1900	David de Beck, M.D.	Cincinnati.
1901	George W. Crile, M.D.	Cleveland.
1903	William S. Carter, M.D.	Galveston.
1905	D. Chalmers Watson, M.D.	Edinburgh (Scotland).
1907	William Louis Chapman, M.D.	Providence.
1908	William T. Shoemaker, M.D.	Philadelphia.
1910	M. Katzenstein, M.D.	Berlin (Germany).
1911	Francis D. Patterson, M.D.	Philadelphia.
1914	H. B. Sheffield, M.D.	New York.
1915	J. E. Sweet, M.D.	Philadelphia.
1917	Wilburt C. Davison, M.D.	Baltimore.
1921	John W. Churchman, M.D.	New York.
1923	Edward P. Heller, M.D.	Kansas City, Mo.
1924	Gordon Cameron, M.B., B.S.	Victoria, Australia.
1925	Raphael Isaacs, M.D.	Boston.
1926	P. S. Pelouze, M.D. and Frederick S. Schofield, M.D.	Philadelphia.
1927	Emil Bogen, M.D.	Cincinnati, Ohio.
1928	J. Rodman Paul, M.D. and William U. McClenahan	Philadelphia.

NATHAN LEWIS HATFIELD PRIZE FOR ORIGINAL RESEARCH IN MEDICINE

(Triennial)

1901	Henry F. Harris, M.D.	Atlanta.
1909	Martin Henry Fischer, M.D.	Oakland.
1917	A. B. Macallum, M.D., F.R.S.	Toronto.
1919	Harvey Cushing, M.D.	Boston.
1921	William R. Nicholson, M.D.	Philadelphia.
1922	Sir Thomas Lewis, C.B.E., M.D., F.R.S.	London (Eng.).
1923	Frederick Grant Banting, M.D.,	Toronto.
1924	George J. Heuer, M.D.	Cincinnati.
1926	Knud Faber, M.D.	Copenhagen.
1928	John James R. Macleod	Toronto, Can.

NOTE.—November 29, 1913, by Supplemental Deed of Trust, the title of this Fund was changed to "Nathan Lewis Hatfield Prize and Lectureship."

WEIR MITCHELL LECTURES

Jan. 17, 1911	Arthur R. Cushny, M.D.	London.
Mar. 30, 1911	Edmund B. Wilson, Ph.D., LL.D.	New York.
May 16, 1911	Svante Arrhenius	Stockholm.
Nov. 3, 1911	William T. Porter, M.D.	Boston.
Mar. 29, 1912	William H. Howell, M.D.	Baltimore.
Oct. 21, 1912	G. H. F. Nuttall, F.R.S., M.D.	Cambridge (Eng.).
April 4, 1913	H. P. Armsby, Ph.D., LL.D.	Pennsylvania.
Feb. 25, 1914	Harvey Cushing, M.D.	Boston.

PUBLIC LECTURES

Feb. 16, 1910	S. Weir Mitchell, M.D.	Philadelphia.
Nov. 17, 1910	Simon Flexner, M.D.	New York.
Dec. 15, 1910	William H. Welch, M.D.	Baltimore.
April 18, 1911	James G. Mumford, M.D.	Clifton Springs, N.Y.
Nov. 20, 1911	Talcott Williams, A.M., LL.D., Litt.D.	Philadelphia.
April 29, 1912	Owen Wister, A.M., LL.D.	Philadelphia.
Feb. 17, 1913	John K. Mitchell, M.D.	Philadelphia.
Feb. 15, 1916	Daniel J. McCarthy, M.D., and Walter Estell Lee, M.D.	Philadelphia.
April 15, 1916	Surgeon A. M. Fauntleroy	U. S. Navy.

MARY SCOTT NEWBOLD LECTURES

Mar. 29, 1917	A. T. McCormack, M.D.	Bowling Green, Ky.
April 4, 1919	Col. Thomas W. Salmon, M.C.,	U. S. Army.
Feb. 6, 1920	Alonzo E. Taylor, M.D.	Philadelphia.
Feb. 4, 1921	Maj.-Gen. Merritte W. Ireland	Washington.
April 20, 1921	Prof. William Romaine Newbold,	Philadelphia.
Nov. 11, 1921	Robert McCarrison, M.D., D.Sc., LL.D.	Oxford (Eng.).
Feb. 1, 1922	Hans Zinsser, M.D.	New York.
April 5, 1922	G. Canby Robinson, M.D.	Baltimore.
Dec. 6, 1922	Donald C. Balfour, M.D.	Rochester, Minn.
Mar. 7, 1923	J. J. R. Macleod, M.D.	Toronto.
April 4, 1923	Prof. Leon Asher, M.D.	Berne (Switzerl'd).
Mar. 5, 1924	Prof. A. Biedl	Prague (Czecho-Slovakia).
April 15, 1924	J. G. FitzGerald, M.D.	Toronto.
Oct. 31, 1924	John I. Hunter, M.D., and N. D. Royle, M.D.	Sydney (Australia).
Dec. 4, 1924	Willem Einthoven, M.D.	Leyden (Holland).
April 21, 1925	A. N. Richards, A.M., Ph.D.	Philadelphia.
Feb. 2, 1927	Eugene L. Opie, M.D.	Philadelphia.
Nov. 2, 1927	George R. Minot	Boston.
Mar. 22, 1928	Sir Humphry Rolleston, Bart., M.D.	Cambridge (Eng.).
Nov. 7, 1928	Ralph Pemberton, M.D.	Philadelphia.

MÜTTER LECTURES

1865	J. H. Packard, M.D.	Philadelphia.
1866	J. H. Packard, M.D.	Philadelphia.
1867	J. H. Packard, M.D.	Philadelphia.
1868	Harrison Allen, M.D.	Philadelphia.
1869	J. H. Brinton, M.D.	Philadelphia.
1872	J. da S. Solis Cohen, M.D.	Philadelphia.
1879	S. W. Gross, M.D.	Philadelphia.
1882	E. O. Shakespeare, M.D.	Philadelphia.
1885	H. F. Formad, M.D.	Philadelphia.
1888	O. H. Allis, M.D.	Philadelphia.
1890–1891	Roswell Park, M.D.	Buffalo.
1893–1894	De Forest Willard, M.D., and Guy Hinsdale, M.D.	Philadelphia.
1896	O. H. Allis, M.D.	Philadelphia.
1899–1900	J. B. Roberts, M.D.	Philadelphia.
1901	H. W. Cushing, M.D.	Boston.
1902	L. A. La Garde, M.D.	Washington.

1903	C. N. B. Camac, M.D.	New York.
1904	G. H. Monks, M.D.	Boston.
1905	A. O. J. Kelly, M.D.	Philadelphia.
1906	W. J. Mayo, M.D.	Rochester, Minn.
1907	J. Rogers, M.D., and S. P. Beebe, M.D.	New York.
1908	G. W. Crile, M.D.	Cleveland.
1909	H. D. Fry, M.D.	Washington.
1910	T. W. Hastings, M.D.	New York.
1911	C. F. Nassau, M.D.	Philadelphia.
1912	J. C. Bloodgood, M.D.	Baltimore.
1913	R. C. Coffey, M.D.	Portland, Ore.
1914	F. H. Albee, M.D.	New York.
1915–1916	Rudolph Matas, M.D.	New Orleans, La.
1916	Nelson M. Percy, M.D.	Chicago, Ill.
1917	Chevalier Jackson, M.D.	Philadelphia.
1919	Alexis V. Moschcowitz, M.D.	New York.
1920	J. Chalmers Da Costa, M.D.	Philadelphia.
1921	Prof. H. C. Jacobaeus	Stockholm (Swed.).
1922	James Ewing, M.D.	New York.
1923	J. Edwin Sweet, M.D.	Philadelphia.
1924	Evarts Graham, M.D.	St. Louis.
1925	Edward Archibald, M.D.	Montreal, Can.
1926	Walton Martin, M.D.	Ithaca, N. Y.
1927	E. Starr Judd, M.D.	Rochester, Minn.
1928	Herbert W. Carson, M.D.	London (Eng.).

WEIR MITCHELL ORATION

1919	Charles W. Burr, M.D.	Philadelphia.
1922	Charles Loomis Dana, M.D.	New York.
1925	Simon Flexner, M.D.	New York.

MEMOIR OF JOHN GOODRICH CLARK, M.D.*

By EDWARD MARTIN, M.D.

Born, 1867. Preliminary Education: Earlham College, Ohio Wesleyan University.

University of Pennsylvania, M.D., 1891; St. Agnes Hospital and Children's Hospital of Philadelphia; Bellevue Hospital, New York; Johns Hopkins Hospital, Baltimore; clinics and laboratories of Leipsic, Prague, Vienna, London and Paris.

Associate in gynecology, Johns Hopkins Medical School, 1898; professor of gynecology, University of Pennsylvania, and gynecologist-in-chief to the University Hospital, 1899–1927.

Member of the General Medical Committee of the Council of National Defence, 1917.

President of the American Gynecological Society; of the Clinical Conference of Surgeons of North America; of the Medical Club of Philadelphia; chairman, Gynecological and Obstetrical Section and Board of Public Instruction, American Medical Association.

Member: College of Physicians and of the Academy of Surgery, Philadelphia; Board of Regents, American College of Surgeons; American Medical Association; International Surgical Society; Southern Surgical Association. Honorary member, Edinburgh Obstetrical Society.

Consultant of the Clinical Surgical Society of America. Member of fraternities; students' organizations; country clubs.

When John Clark came home from the Ohio Wesleyan University, his father, a successful merchant, said to him: "How would thee like to join me in business?"

John answered: "Father, I would like to join thee in anything and everything else but business. I have always wanted to be a doctor, and I do not think I could be happy or even content at anything else."

His father replied: "Search thy heart diligently, and if that is surely thy feeling I will help thee."

There was so little need of heart-searching that John helped himself by taking the first position which offered a wage which might

* Read January 9, 1928.

defray the cost of his medical education; this in a surveying gang then plotting a part of one of the transcontinental railroad systems.

His preparation for that high place in surgery which deservedly came to him was sound, thorough, deliberate and comprehensive. He entered the medical department of the University of Pennsylvania, selecting as his preceptor America's most brilliant therapeutist, Dr. Hobart A. Hare. After graduation he had a varied intern service in the St. Agnes and Children's Hospitals of Philadelphia; in the surgical wards of the Bellevue Hospital of New York; in the Johns Hopkins Hospital of Baltimore, as Dr. Howard Kelly's resident and later as his associate. Two years were then devoted largely to research in the laboratories of Leipsic and Prague and the clinics of Vienna, Paris and London.

Thus for thirteen years, at large financial output and negligible return, he supplemented a natural aptitude for the practice of surgery by an intensive study which, as evidenced by his productive researches, by his writings, his teaching and his operative skill, fitted him to occupy that place of honor, trust and responsibility implied by a professorship in a leading medical school.

In 1899 he was elected professor of gynecology in the University of Pennsylvania and gynecologist-in-chief to the University Hospital.

As professor of gynecology he devoted his time, thought and energy to the organization of his department, the securing and training of able personnel, the equipment and conduct of his wards, and particularly to the wise and helpful guidance of his students.

He regarded as a by-product that large and lucrative practice which quickly came to him.

In its ultimate development, due to Mrs. Clark's sympathetic understanding and fostering care, Ward K was his special pride: Cubicles set quite apart for postoperative care; space, light, air, comfortable and attractive furniture, flowers, harmonious colors, books, magazines for the convalescents. Most important, a chief nurse, Miss Baker, endowed with both head and heart. "Ritz-Carlton luxuriousness," said a hardened hospital official. Not so! The patients who rose up to call him and her blessed who had in this way lessened the tedium and burden of illness.

There is an innovation of Dr. Clark's devising being widely imitated: In his clinic his arena is completely separated from the seats for students and visiting surgeons by a partition which can be raised or lowered. Behind this lowered screen preparations for operation

are completed, while to the audience in front of it is read an abstract of the case history, followed by lantern-slides demonstrating the steps of the proposed operation and the anatomy involved. Operation begins at once when the partition is raised.

To this clinic came surgeons from all parts of the world. In answer to their words of grateful appreciation of the value of his teaching and the smooth, swift, skilful conduct of his operations, he always said, "Give the credit to my team, not to me."

In his teaching Dr. Clark largely discarded formal lectures, replacing them by conferences and clinical studies, which he enriched by a wealth of always apt and often amusing anecdotes and reminiscences, by lantern slides, by skilful, swiftly-executed drawings and by deft modeling with plastic material.

Deeply interested in research, he founded the Undergraduate Medical Association, holding annually a one-day meeting, at which, all regular classes being suspended, were read and discussed papers based on the clinical studies and experimental investigations of the students.

He refused the tempting offers of publishers to write a textbook, but contributed largely to current literature, averaging two major papers yearly.

He formulated, definitely and authoritatively, the indications and limitations of radium in gynecology, and with Dr. Charles C. Norris published a monograph on this subject.

Dr. Clark was a handsome, powerful, upstanding man; stern and uncompromising with the persistently laggard and derelict; tenderly considerate of the rights, sensibilities and harmless prejudices of others; interested in their problems, and eager to help; according all credit to others and seemingly unaware of his own splendid achievements. He worked and played with a fervid intensity, which upon his colleagues, assistants, nurses and patients acted as a powerful and vivifying tonic; upon his companions in travel or sport as a cheering stimulant.

When down the long ward was heard his approaching step, and often an echo of his laugh, to the faces of even the gravely ill there came the shadow of a smile, and the tired probationer thought, "He makes play out of work."

When in the days of the bike, being a century-run addict, he lured a friend for a jaunt, while the day was still young the latter would groan, "He makes work out of play." He was a wise and enthusi-

astic golfer, coloring the game by quip and jest and gibe and story and diverting repartee, shouting with mirth when his own ball or that of his opponent completely dodged the stroke or plunked in a pond or scurried to a bramble patch. Honorably recording his strokes but indifferent as to the sum total, he regarded the game as a restful, relaxing, delightful open-air social function. His most precious possession was a baffy, with which he wrought marvels; his proudest boast, a drive of 320 yards, which he made on the links overlooked by the pyramids.

In his joyous exuberance of spirits he would occasionally impersonate others when telephoning his friends. Priding himself on his wariness against reprisals, when of an evening the name Ethel Barrymore came over the 'phone, he, not knowing her, identified a colleague at once and answered in some such words as these: "If, Ethel, you do not stop drinking methyl ethyl, you will be nothing butyl. Ethel, also, you may come to dinner tonight, Ethel, if you promise not to boast of it afterwards, Ethel." It really was Ethel Barrymore and even John Clark had trouble making peace.

Dr. Clark left a heritage of life and health to many thousands who came to him with little hope for either; a heritage of high ideals, of human sympathy and understanding, of skilled service, to other thousands of colleagues and students. To the University of Pennsylvania the heritage of a perfectly organized clinic, endowed for research, headed by able men of his own training, carrying on even as did he. To his close friends the heritage of an inspiring, priceless memory.

In the sixteenth chapter of first Samuel, David is described as "Of a beautiful countenance and goodly to look to. A mighty, valiant man, prudent in matters and a comely person, and the Lord is with him." This, and far more, was, and to his intimates is, John Clark.

MEMOIR OF EDWARD E. MONTGOMERY*

By WILMER KRUSEN, M.D.

"No custom is more beautiful than this, when we pause for a moment while we recall memories of some Fellow no longer present," thus has written one of our Fellows. As student, assistant and friend, I appreciate this opportunity to pay a tribute of affection and respect to the memory of Edward Emmet Montgomery.

"Death is a part of life and no man is fit subject for biography until he is dead. Living men have been made themes for biography, but the choice defies the cardinal condition of completeness." Dr. Montgomery lived for nearly four score years, and spent fifty-five years of his life in the city of Philadelphia, as medical student, intern, practitioner and teacher.

Time permits but a brief summary of his life and achievements. He was born on May 15, 1849, in Newark, Ohio. He was the son of Henry A. and Mary E. (Lemert) Montgomery, the former, whose father came to America in 1802, being of Scotch-Irish descent, and the latter of Scotch and French extraction.

Dr. Montgomery spent his boyhood on the family farm. His early education began in the local district schools. At the age of sixteen he entered Denison University of Ohio, from which institution he graduated with the degree of Bachelor of Science. His health as a boy had been unsatisfactory and he was twice compelled to leave Denison because of severe illnesses, but, nevertheless, he received his B.S. in less than three years.

He selected medicine for his lifework, and prepared for medical college under the preceptorship of Dr. J. J. Hamill, of Newark, Ohio, and while working with him was at the same time teaching in the public schools. The relationship between him and his preceptor was a most delightful one, and to recall it makes us long for a return of those days when that personal and intimate companionship between student and graduate physician was a prelude to the college education. Many of his early students and assistants remember the pride with which he introduced Dr. Hamill—a splendid

* Read January 9, 1928.

physician of the old school—to them on visits of the older man to his clinics in this city.

E. E. Montgomery entered Jefferson Medical College in 1872 and graduated in 1874. He was president of his class. His internship, 1874 and 1875, was spent at the Philadelphia General (Blockley) Hospital. He devoted a few years to general practice. During this time he taught physiology in the Jefferson Medical College, as well as anatomy. In 1878 and 1879 he taught private classes in operative surgery in the Woman's Medical College of Pennsylvania, and was clinical surgeon in the Woman's Hospital.

In 1878 he was elected to the obstetrical staff of the Philadelphia General Hospital, a position which he held until 1893. It was in this institution that Dr. Montgomery performed the first successful ovariotomy before a public clinic in Philadelphia.

He was one of the first to practise intubation in this city. The first case he treated was a patient of Dr. John W. West, who was at that time his assistant. The date of the intubation was August 16, 1887, and for several years afterward he did many intubations, until his increasing work in abdominal surgery led him to abandon the former type of work.

From 1886 to 1891 he was professor of gynecology in the Medico-Chirurgical College, and from 1891 to 1892 he filled the chair of obstetrics and gynecology in that institution. From 1892 to 1898 he was professor of clinical gynecology in Jefferson Medical College and professor of gynecology in 1898. For thirty-five years he was chief gynecologist to St. Joseph's Hospital and consulting gynecologist for the Kensington Hospital for Women and the Philadelphia Lying-in Hospital.

He was the author of the well-known textbook, *Practical Gynecology*, and a contributor to the *American Textbook of Gynecology*, Keen's *Surgery* and other works.

Dr. Montgomery was a member of the following societies: Philadelphia County Medical Society, Medical Society of the State of Pennsylvania, College of Physicians of Philadelphia, Obstetrical Society of Philadelphia, Philadelphia Clinical Society, Medical Club of Philadelphia, American Gynecological Society, American Association of Obstetricians, Gynecologists and Abdominal Surgeons.

Dr. Montgomery served as a member of the board of trustees of the American Medical Association for a period of fifteen years, and was first vice-president of the Association in 1909. He was at one time president of the American Association of Obstetricians and

Gynecologists, also of the County Medical Society, of the Medical Society of the State of Pennsylvania and of the Alumni Association of Jefferson Medical College. He was the founder of the Ohio Society of this city and was at one time its president.

On December 27, 1876, Dr. Montgomery married Helen Buckley, who died in September, 1913, after a long illness. There were two children by this marriage, one of whom died in infancy, the other is now the wife of Pascal Brooke Bland, one of our Fellows. In 1917 Dr. Montgomery married Alice Jayne, of Tarrytown, N. Y., who survives him.

Dr. Montgomery retired from active practice in the autumn of 1923 and traveled extensively, writing most interesting accounts of his experiences, which appeared through the medium of one of our medical journals.

It is difficult for me to describe that evasive something that we call personality in an individual, but I recall him vividly as I first knew him: tall, handsome and physically imposing; dignified and reserved, and with a dominating and commanding manner. He was kindly and affectionate in his family relationships and greatly beloved by his patients. He was a man of indefatigable industry, impervious to criticism when he believed himself to be in the right, sincere in his religious beliefs, and always an advocate of the high standards of ethics in professional and private life. His natural modesty and reserve prevented him from expressing, as fully as often he would have liked to have done, his keen interest in the lives and welfare of the students in his classes. Nothing gave him greater happiness than to have them in his home, where the social side of his nature was often surprisingly exhibited, and those who knew him intimately found that he had a fund of amusing stories and a keen sense of humor unsuspected by casual acquaintances.

He was a man of strong convictions and believed firmly in medical organization, giving of his best to the medical societies with which he was affiliated, notably to the American Medical Association, which he served so faithfully, and to the College of Physicians, which has received generous gifts from him. In his death the medical profession has met a grievous loss. He was ever ready with his time, ability and wisdom to serve his professional brothers and the members of their families as well as the great public.

Skilful and courageous as a surgeon, loyal and faithful as a friend, a good citizen, independent in thought and action, he won for himself the high place he occupied in this city.

MEMOIR OF MILTON BIXLER HARTZELL, M.D.*

By FRED D. WEIDMAN, M.D.

Milton Bixler Hartzell, A.B., A.M., LL.D. (Gettysburg College), and M.D. (Jefferson College), was born at Fayetteville, Pennsylvania, in 1854. His father was a physician, and his brother, Charles A., also became a physician. The latter is still in active practice at Fayetteville. Milton B. was graduated from Jefferson in 1877. Dr. Edgar F. Smith and Judge Dimner Beeber, both of this city, were numbered among his classmates at Gettysburg, and Dr. John Marshall was a member of a class only two or three years back.

Dr. Hartzell never married. Graduating in 1877, he became a successful general practitioner and remained such for many years before confining himself to dermatology. I recall well the Dr. Hartzell of those days, having been treated by him when a small boy for an insect which had crawled into my ear. He flushed it out with warm water from a gigantic hard-rubber syringe, which I shall never forget. He had a forceful personality, was portly without being obese, and was active and decisive both in thought and movement. In later years he became an even more commanding figure by reason of his strongly knit eyebrows; these maintained their original dark color and contrasted with the gray of his scalp and heavy mustache.

Dr. Hartzell had a large general practice, and it is to his credit that he was one of the pioneers of those who are so numerous today who can and will cull enough time out of the twenty-four hours to engage in laboratory work in addition to their general practice. We find him registered as pathologist to the Presbyterian Hospital between the years 1885–1890; this, it must be remembered, was at a time when pathology was comparatively an infant. I am told that after the daily rounds of practice he would spend evenings in his laboratory at home cutting sections and experimenting with the aniline dyes which were just coming into use. The effect of this training remains impressed upon Hartzell's work; the pathologic and particularly the histopathologic portions of Hartzell's publica-

* Read January 9, 1928.

tions lifted them into a position of distinction which compared more than favorably with the average contemporary. He was a photographic artist—not only in the gross, but of histologic sections. To this day there is not a textbook in dermatology in which the photographs and photomicrographs are as uniformly excellent as in Hartzell's text; furthermore, almost every illustration, 242 of them, in that work is an original!

Hartzell's dermatologic career began in 1884 with an assistantship in the newly opened skin dispensary of the University Hospital. Here he was fortunate in the mastership of Louis A. Duhring; it is postulated even today that expert preceptorship is a *sine qua non* for the development of initiates in such a specialty as dermatology. In 1891 he became instructor in dermatology and assistant-in-charge of the skin dispensary of the University Hospital. When Duhring retired, in 1911, Hartzell became the professor of dermatology at the University.

Dr. Hartzell held membership in the following organizations: the Union League, the Sigma Chi and the Phi Rho Sigma medical fraternities. Other activities were: clinical professor of dermatology at the Woman's Medical College of Pennsylvania; president of the American Dermatological Association; member of the Philadelphia County and Pennsylvania State Medical Societies, Pathological Society of Philadelphia, Philadelphia Dermatological Society, College of Physicians of Philadelphia, dermatologist to the Methodist-Episcopal Hospital and the Philadelphia General Hospital, and patron of the Hartzell Dermatological Research Society. Upon his retirement he was honored as the emeritus professor of dermatology of the University of Pennsylvania.

His contributions to medical literature are too numerous to give in detail in this place. However, there are some observations upon them in general which may well be in order. They were easy to read, because they were written in such refreshingly direct Anglo-Saxon. This was rather remarkable in view of the German influence on medical literature which was current at that time and Hartzell's many visits to the Continent. His publications would have been more numerous did he not refrain from rushing into print. I have personal knowledge of his policy of purposely deferring publications until his article had mellowed and he was able to secure a second perspective of the situation. His textbook, *Diseases of the Skin*, is doubtless his *opus magnum*. He regarded as his greatest distinction

in the literary way the inclusion of his paper on "Cancer in Arsenical Hyperkeratoses" in the *Transactions* of the New Sydenham Society.

Hartzell was in the class of those ordinarily regarded as "not approachable." His circle of intimates, both medical and social, appears to have been contracted. He did not have any cronies as far as I have been able to find out. Yet, once well known, he was affability personified, and after the ice was broken thoroughly enjoyed close personal contacts. As Judge Beeber put it: "He was not a mixer; this was a definite handicap to the advancement of a scholar whose native ability and application merited greater recognition and popularity. Everything that he attained was by sheer merit."

Hartzell was one of the most forceful characters in American dermatology. He had opinions on almost every subject. They were definite and sane, and the evidence had to be unequivocal to make him change his opinions. His obvious and downright honesty and his devotion to the welfare of dermatology were self-evident—almost fanatic; these, coupled with his native common sense and ability commanded attention to him when he was on his feet in dermatologic discussion. He was impetuous! His mind worked like a flash; he instinctively sensed an administrative or medico-political situation at sight. He was a tory in the best sense of the word; the newest medical fad was to him an interloper. It was guilty until proven innocent. He despised and openly expressed himself against the type of physician more vulgarly designated today as the "go-getter," and more gently as "aggressive," as a subtle agent in destroying time-honored medical traditions and replacing them with modern competitive and other business principles. His character was sterling and his methods straightforward. Back-door methods of subterfuge and expedience were unknown to him. He was a rugged stickler for promptness, economy, accuracy and scientific honesty. These qualities naturally made him a member of that group which makes for steadiness and solidness and which is so necessary in all organizations and vocations.

Hartzell retired from his professorship in 1922, following a mild apoplectic stroke. It is not surprising, after what has just been said, that he promptly retired from all activities, dermatologic and otherwise. The remaining five years of his life were spent in Fayetteville, nearby the home of his brother. He died in April, 1927, of angina pectoris.

Dr. Hartzell's last service to the University came in the form of a bequest of $100,000 for research in applied therapeutics. No one seems to know why he saw fit to dispose it thus instead of to his own specialty. Perhaps this is only another expression of Hartzell's breadth of vision, broad enough to see beyond his own environment and in favor of the University and medicine as a whole.

Milton Bixler Hartzell played the full part in all sectors of his environment—noblest of all as family physician, then as teacher, and finally as an outstandingly forceful and wholesome character and influence in American dermatology.

ANNUAL ADDRESS OF THE PRESIDENT*

By JOHN H. GIBBON, M.D.

This occasion I deem an appropriate one to express to the Fellows of the College my appreciation of the great honor they have done me in making me their presiding officer. With such feelings in my heart I can but manifest them in a conscientious effort to emulate the attitude of my distinguished predecessors toward this venerable College and its activities.

With the changes in our by-laws which have eliminated from our meetings many reports of officers and committees, the annual address of the president must of necessity be a medley of facts relating to the condition of the College and its various activities during the previous twelve months, and, according to precedent, a few wise suggestions as to its functions in the future. I realize that such admonitions are, of course, soon forgotten and but rarely acted upon, and, not wishing to waste your time or my own wise council, my address will be in the nature of a report from which it is hoped you may draw conclusions which will be beneficial to the College.

Finances of the College. Nothing provokes an individual more than to be credited, even by his friends, with wealth which he does not possess, and institutions often suffer from the same misrepresentation. Many Fellows of the college unfamiliar with its income and budget, look upon it as being in a perfectly satisfactory financial condition, when such is far from the truth. Others better informed of the conditions, and realizing our present financial stress, seem to think that as soon as the old building at Thirteenth and Locust Streets is sold our income will easily take care of our expenses. I am sorry to say that this too is not the case.

First, let me tell you about the sale of the old building which we had hoped to consummate some months ago. The purchase price was to be $350,000 and an option of $2500 was paid at once as an indication of good faith; the time arriving for payment of the bal-

* Read, January 7, 1929.

ance, the proposed purchasers were unable to produce the money, but offered another payment of $5000 for a sixty-day extension of the option; this was granted, but at the expiration of the sixty days they were again unable to pay and the $5000 was likewise forfeited. Except for the possession of these sums ($7500) the College is in exactly the position it was before the negotiations were begun. As long as the building was occupied by the Free Library, the College received $10,000 per year rent and paid no taxes on the property. Now we are not only receiving no rent, but are paying $10,000 in taxes and losing the interest on the value of the property, which at 5 per cent is $17,500, so that we are actually out more than $25,000 a year. The income of the College from all sources, except from endowments of lectureships and from other specific endowments of the Library, is about $15,000, and our expenses about $33,000, not including the $10,000 tax on the old building, which, of course, must be paid and raises our present expense account to $43,000. With these figures before them, let no Fellow imagine that our College is in anything but financial embarrassment. We should realize, too, that had the sale of the Thirteenth and Locust Streets property been concluded, our income would still have fallen short of our expenses. It is true that the College has received frequent bequests from Fellows and friends, but these have nearly always been in the form of endowments for special purposes and the income from these cannot be used to meet the yearly running expenses of the College.

I am not asking you to solve this financial riddle, that is for the Committee on Finance, but I am putting before you facts which you should know and remember. It must be apparent to you that, for the present at least, we must resort to economy by cutting down our expenses and to borrowing or the expenditure of principal. These matters are all being considered by the Committee on Finance and will be constantly before the Council. Your Finance Committee has been active during the year and by sale and reinvestment has considerably increased our income from some of the endowment funds. May I suggest that any Fellow wishing himself to make a gift to the College, or who may be consulted by any prospective doner, remember that our present pressing need is an endowment, the income of which may be expended for the general upkeep of the College. This is, in fact, the only suggestion which I make in this report and may I hope that it will not be forgotten.

Economies. It is a difficult matter by economy to materially effect our huge present deficit without seriously interfering with the routine work of the College, but nevertheless the Council has asked the various Committees to exercise all possible saving in the conduct of their business and to bear in mind that much of the money which they expend must come out of principal. Furthermore, the Council has asked the Sections to bear the expense of printing and mailing their notices of meetings, a change which will result in a saving to the College of about $400 a year, and yet when distributed over the various Sections will add little to their financial burdens. The closing of the Library at night would save an expenditure of some $700 a year, but such an economy would be offset by its effect on the function of the Library. In fact, the Council would rather extend than curtail the evening hours, and hopes that the time will come when those wishing to use the Library at night will find it open to them every evening.

Scientific Meetings. Due to the activities of the Committee on Scientific Business, and the committees in charge of the various endowed lectureships, we have had nine interesting meetings at which we had twenty valuable papers, and the attendance of the Fellows was considerably higher than in the previous year.

At the May meeting Dr. Allen W. Freeman, of Baltimore, read a paper on "The Present Needs and Future Possibilities in Preventive Medicine," and Dr. James M. Anders discussed "Certain Clinical Aspects of Immunization in Communicable Diseases of Childhood."

The Mütter Lecture was given at the December meeting by Herbert W. Carson, F.R.C.S., of London, his subject being "Cancer of the Colon."

Probably the most successful meeting of the year was that of March, which was held in commemoration of Harvey's publication of *De Motu Cordis.* On this occasion Sir Humphrey Rolleston, of London, delivered the nineteenth Mary Scott Newbold Lecture, his subject being "Harvey's Predecessors and Contemporaries," and Professor James J. R. Macleod, of Toronto, gave the eighth Nathan Lewis Hatfield Lecture, his subject being "Harvey's Experiments on Circulation."

The Royal College of Physicians of London, having invited the College of Physicians to send a delegate to its Harvey Tercentenary Celebration, Doctor Francis R. Packard was appointed, and later represented the institution at this conspicuous celebration in London.

The twentieth Mary Scott Newbold Lecture was given at the November meeting by Dr. Ralph Pemberton, who discussed "Arthritis."

Memoirs. At the stated business meeting in May memoirs were read of Dr. Milton B. Hartzell by Dr. Fred D. Weidman; of Dr. Edward E. Montgomery by Dr. Wilmer Krusen, and of Dr. John B. Clark by Dr. Edward Martin.

The Alvarenga Prize for 1928 was awarded to Dr. J. Rodman Paul and Dr. W. U. McClenahan, of Philadelphia, for their essay on "Pathological Study of the Pleural and Pulmonary Lesions in Rheumatic Fever."

Membership. On December 1st there were 520 Fellows and 21 Associate Fellows (13 American and 8 Foreign). During the year 30 new Fellows were elected, 10 died and 3 resigned.

Deaths. A sad duty of your presiding officer at this time is to recall to your memories the personalities of the Fellows who have died during the year; but first I must speak of a death which occurred on April 6, 1927, and which through an error was not previously noted. On this date there died, in New York City, one of our very distinguished Associate Fellows, Doctor Robert F. Weir, who was for many years a conspicuous leader of American surgery, a great teacher, a wise writer and a lovable personality.

On January 19, 1928, Doctor Frank W. Thomas died. He was elected a Fellow in 1912, was a consulting physician of the Germantown Hospital and was a fine example of a type which but recently it seemed might become extinct, the family physician.

On February 15, 1928, Doctor Eugene L. Vansant died. He was elected a Fellow in 1893 and will be remembered for his long association with the Philadelphia Polyclinic as one of the professors of otolaryngology.

Doctor Horace Carncross died on March 4, 1928. He was elected to the Fellowship in 1924.

Doctor Alfred Heineberg died on May 13, 1928. He was elected a Fellow in 1908, and was a popular teacher in the field of gynecology.

Doctor William M. L. Coplin, elected a Fellow in 1903, died on May 29, 1928. Doctor Coplin was a distinguished teacher of pathology, a constant contributor to the literature of pathology, and beyond his particular field was conspicuous as a hospital organizer and director.

On November 27, 1928, Doctor T. Mellor Tyson died. He was the son of one of our most beloved and respected presidents and had been of our Fellowship since 1897. During the greater part of his professional life he was one of the physicians of the Rush Hospital.

Doctor Robert Abbe, of New York, an Associate Fellow and a benefactor of the College died on March 7, 1928, and on the recommendation of the Censors a memoir of this distinguished surgeon will be read at the May meeting by Doctor William J. Taylor.

On April 16, 1928, Doctor Morris J. Lewis, a Fellow since 1877, died, and the Censors recommended that a memoir of him should be read. This memoir will be presented at the May meeting by Doctor Charles W. Burr.

The Library. The reputation of the College, both in this country and abroad, is due largely to its Library, which is one of the great medical libraries of the world. The very complete report of the Library Committee shows that during the past year its function has been quite up to the standard and that valuable additions have been made, the increase in volumes being 2667. The total number of volumes is now 158,041, the number of unbound theses and dissertations 30,771, the number of unbound pamphlets 169,898 and the number of manuscripts 435. The incunabula now number 365 volumes. A long list of rare and valuable books has been added during the year by gift and by purchase. In this connection I would call your attention to the list of additions to the Library which is published in our monthly programs. The Library has been used by 8687 individuals; visitors, 6938, and Fellows, 1748.

An endowment of $5000 has been received from Doctor Augustus A. Eshner, the income of which will be used for the purchase of books and the fund will bear his name.

Although the number of volumes may give some idea of the value of a library, the real criterion is the use which is made of them. Of course, certain rules and regulations must be observed for the safeguarding of our books, but the Committee has tried to be as liberal as possible. Both Fellows and visitors should be encouraged to use the Library, and every courtesy and aid should be extended to them. Any other attitude on the part of the employees is detrimental to the College.

The Nurses Directory, the only paying function of the College, has continued its good service to the public and the profession and has turned over a considerable balance to the treasury.

The Sections. The sections have all had a verys uccessful year, with increase in interest and attendance.

I am sure I represent your sentiments when I thank the employees of the College for their faithful and devoted service.

In concluding, I should like to express to the Secretary of the College, to its treasurer and the chairman of the various committees my obligation for the facts which I have set before you and for their courtesy and support during the past twelve months.

BLOOD DONORS: A STUDY OF THE EFFECT IN DONORS OF REPEATED BLOOD LOSS*

By HAROLD W. JONES, M.D.

AND

HERBERT WIDING, M.D., AND LYLE NELSON, M.D.

(By Invitation)

(From the Medical and Therapeutic Departments of the Jefferson Medical College Hospital.)

The effect of blood loss in donors has not received the careful attention which the subject warrants. Most of the studies[1,2,3,4] have been limited to notations concerning health, the necessity of repeated Wassermann tests and the careful matching of blood. It is reported that in one institution a student is permitted to donate blood only once in a semester. This rule was made because one of the students fell seriously ill following a blood donation. McNamara has stated that he does not make routine Wassermann tests on his donors, as most of those available have lues, and in his experience the disease was not transmitted if present in the tertiary stage. Giffin and Haines,[5] from a study of donors made at indefinite intervals after blood donation, concluded that bloodletting every four or five weeks was not harmful; that women developed anemia more rapidly and recovered more slowly than men; that 27 per cent felt improved in health; that 50 per cent gained weight and that blood-volume studies showed no change in plasma and cell volume.

In this report a detailed study of the effect of bloodletting on 50 donors in 175 transfusions is presented. Hemoglobin, red cells, white cells, blood plates, clotting time, volume index, vital capacity and weight are estimated before and after each transfusion. An attempt to show the effect of blood loss in successive donations is made and the time elapsing before the blood returns to normal is included. The number, the interval between donations and the time elapsing since the first donation are indicated also.

* Read, January 4, 1928.

Only 5 of the donors are females. The youngest male is twelve and the oldest forty-one years of age. They are grouped according to age in the chart shown below:

Age	12	21	22	23	24	25	26	27	28	29	30	31	32	34	35	37	41
Males	1	3	3	7	7	3	6	2	3	0	1	1	1	3	2	1	2
Females	..	..	..	..	..	1	..	..	..	..	..	..	1	1	1	..	1

All but 3 of the donors have given blood more than once. The greatest number given by one donor was fifty-four. In the chart below the donors are grouped under the number of donations given:

Donations	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Males	3	1	1	4	1	2	1	2	2	3	1	..	1	1	1
Females	..	..	..	2	1	1	..	1							

Donations	16	18	24	25	28	32	54
Males	1	1	1	1	1	1	1
Females							

Whenever possible studies were made in successive transfusions, so that the effect of repeated blood loss might be more closely observed. The average reduction of hemoglobin in males was 4 per cent, and of red blood cells 300,000, whenever approximately 400 cc. were given. With the use of this amount the greatest reduction of hemoglobin was 8 per cent (78 to 70 per cent), and of red blood cells 720,000 (5,520,000 to 4,800,000). One donor showed a reduction of hemoglobin from 98 to 76 per cent and red blood cells from 5,400,000 to 3,980,000 when 1200 cc. were given in fourteen hours. Donor No. 6 made six donations (1800 cc.) in twenty-three days. The hemoglobin dropped from 95 per cent to 79 per cent, and red blood cells from 5,000,000 to 3,650,000, but in five days the hemoglobin was 90 per cent and red blood cells 4,520,000. Donor No. 29 possessed marked regenerative powers. He made five donations (2000 cc.) in eighteen days, with a reduction in hemoglobin from 98 to 83 per cent and of red blood cells from 5,240,000 to 4,500,000. In ten days the hemoglobin was 105 per cent and the red blood cells 6,240,000. Another transfusion of 400 cc. reduced the hemoglobin to 100 per cent and red blood cells to 5,800,000. Donor No. 10 also demonstrated unusual ability to regenerate during the course of a series of transfusions. He made three donations (1200 cc.) in ten days. The hemoglobin was 98 per cent, red blood cells 5,400,000 before and 93 per cent hemoglobin and 5,430,000 red

blood cells after the last donation, which was his nineteenth in seventeen months.

Clotting Time. The clotting time was estimated before and after each donation. The alteration was slight. There seemed to be some tendency to lengthening after several donations in succession were made. This change, however, was so slight that the estimation was omitted in many of the studies.

Volume Index. The estimation of volume index (Haden) did not prove to be of any significance. The changes were slight and indefinite.

Blood Plates. The blood plates were counted before and after each transfusion. Definite conclusions could not be drawn.

Vital Capacity. The variation in vital capacity before and after donation was not marked. At times the total expired volume was increased and at other times decreased. Many of the donors showed a decided increase after making several donations. It was not evident whether this was due to increased capacity or to greater skill of operation. The greatest increase was 250 cc. In each donor an increase was associated with weight increase.

Weight Change. Whenever 300 to 400 cc. of blood were donated there was a loss in weight of from 0.5 to 1 pound. One donation of 800 cc. resulted in a loss of 1.5 pounds. All male donors except two who made more than one donation gained weight. One lost 1.5 pound and the other showed no change. The gain in weight varied from 1 to 13 pounds. The 13-pound gain was in Donor No. 24 and took place over a period of two years.

Male and Female Donors. Giffin and Haines stated that female donors developed anemia more quickly and recovered more slowly than male donors. In the present report studies of only 5 female donors are included. We have avoided using female donors, as their veins are usually small or obscured by superficial fat. We agree with Giffin and Haines that in most females with a donation of 400 to 500 cc. an anemia quickly resulted and the return to normal was slow. Donor No. 17 demonstrated this point. Her hemoglobin changed from 96 to 68 per cent and red blood cells from 4,780,000 to 3,600,000 after four donations in sixteen days (1560 cc.). But Donors Nos. 47 and 48 gave four transfusions each in a period of thirty days with but little more reduction than would have occurred in the male; they gave, however, approximately 300 cc. at each transfusion. This point is discussed under "Small *vs.* Large

Donations." One of the 5 donors, No. 28, was a robust, florid individual who donated seven times in thirty-five days (2740 cc.). The hemoglobin was 80 per cent and red blood cells 4,220,000 after the last donation. Two of the 5 donors gained in weight.

Small vs. Large Donations. The question of small or large donations is important. Giffin and Haines stated that 500 cc. may be given with safety every four to five weeks. In the foregoing paragraphs the effect of repeated donations of small amounts of blood was discussed. Donors have been used at three- to five-day intervals, six and seven times without being seriously affected either symptomatically or systemically. However, whenever larger amounts of blood were given considerable effect was noted. One donor, not included in this report, gave 380 cc. with a drop in hemoglobin from 95 to 92 per cent, red blood cells 5,000,000 to 4,640,000. Two days later, at another institution, he gave what he thought was 500 cc. but felt so weak after the donation that he was unable to walk home. The following day his hemoglobin was 60 per cent, red blood cells 3,200,000 and he was 4 pounds lighter than before the first donation. It was discovered that 1000 cc. of blood had been used. A month later the hemoglobin was 86 per cent and red blood cells 4,470,000. Other donors have reported similar experiences. Our donors who knowingly have given large amounts of blood have been unfavorably affected by the loss. Donor No. 44 gave 1000 cc. in eight hours (two donations). His hemoglobin dropped to 70 per cent and the red blood cells to 3,700,000. He remained in the hospital for one night; following this for several days he complained of lack of energy and sleeplessness. Five weeks later the hemoglobin was 88 per cent and red blood cells 4,520,000. Donor No. 32 gave 1200 cc. in fourteen hours, with a resultant drop of hemoglobin to 76 per cent, red blood cells 3,980,000. Donor No. 50 gave 800 cc. (two donations) in one and a half hours. The hemoglobin dropped to 76 per cent and red blood cells to 3,800,000. Twelve days later the hemoglobin was 82 per cent and red blood cells 4,860,000. Twenty-five days later the hemoglobin was 90 per cent and red blood cells 4,960,000. Donor No. 35 made three donations in eight days (1620 cc.), with a drop of hemoglobin to 74 per cent, red blood cells 3,560,000 and twenty days later the hemoglobin was 88 per cent and red blood cells 4,600,000. It is evident that the return to normal in most

cases is slow when 500 cc. or more are given at one time, and when 400 cc. or less is donated the return is usually fairly rapid.

Female Donors. Donor No. 47 made four donations of 1460 cc. in four weeks. The hemoglobin fell to 70 per cent and red blood cells to 3,800,000. Fifteen days later the hemoglobin was 82 per cent and red blood cells 4,470,000. Donor No. 51 made six donations in twelve weeks (2600 cc.) with a resultant drop in hemoglobin to 50 per cent, red blood cells 2,980,000, and thirty days later the hemoglobin was 52 per cent and the red blood cells 3,240,000.

It is evident from these results that the ideal amount for donation by males is 400 cc. or less and by females 300 cc. Male donors cannot give blood in amounts of 500 cc. or more at frequent intervals, and female donors stand the loss of 400 cc. or more very badly. We feel that whenever possible male donors should be used. If a female donor is to be used for several transfusions then the amount taken should be approximately 300 cc. emergencies excepted. A robust female donor may occasionally be found who is able to give blood in 400 cc. amounts at frequent intervals without developing anemia. Such an example was Donor No. 28.

Variation in Donors. It must be recognized that the tall, robust donor is able to withstand blood loss better than one of short stature and little weight. We know that a patient of small stature does not require as much blood to produce a given result as does one of large stature. Below is a weight chart of our donors. Thirty weighed more than 160 pounds.

Weight.	Male.	Female.
90 to 100	1	
120 to 130	4	2
130 to 140	2	
140 to 150	6	
150 to 160	5	1
160 to 170	8	
170 to 180	3	1
180 to 190	5	1
190 to 200	6	
200 to 210	5	

The blood of some donors produced a more favorable result, both objectively and subjectively. Donors Nos. 2 and 9 were of this type, while Donor No. 36, although well-built and healthy, often failed to bring about an average change. This might be explained by the variation in the condition of the patient, but when

similar results were noted in several patients it became more than coincidence. It has been our observation that a fat donor does not stand blood loss as well as the robust wiry type. We feel that when 400 cc. of blood are to be used the best type of donor is a male between twenty and forty years of age, 150 pounds or more in weight and of erect, compact stature.

General Considerations. One of us (H. W. J.) has been able to observe the reaction to blood loss in some 400 donors in nearly 3000 transfusions. Usually the donor rises from the table and goes back to work or to the classroom none the worse for the experience. The majority have felt improved by the bleeding. The skin seems clearer and several individuals with acne have reported the disappearance of the lesions, although of long standing. Not a few who were chronically constipated noted the return of normal intestinal function. Most of them stated that they were more able and eager to attend to their usual duties. Whenever the donation has been more than 600 cc. the donor is made to remain in the hospital and fluid is forced. They are then recommended to eat a diet rich in meat and green vegetables for the following week. One donor, six hours after giving 400 cc. of blood, had a severe chill of twenty minutes' duration, followed by a rise in temperature to 104° F. The next morning the temperature was normal. He presented symptoms of a common "cold." The nasal and pharyngeal mucous membrane were injected. In three days he felt perfectly well. As a probable explanation for this reaction it is suggested that he was developing the "cold" before the transfusion and that the loss of blood in itself did not bring about the reaction. Six donors, not medical students, making their first donation, fainted while in a recumbent position. The blood-pressure dropped so rapidly (in one from 120/70 to 72/20 and in another from 126/68 to 64/0) that the lowering of the pressure made it impossible to get blood from the veins and the transfusions were discontinued.

Most of our donors are students. We pay them twenty-five dollars for ward patients and thirty-five to fifty dollars for private patients, for donations of 200 to 500 cc. Over 500 cc. ten dollars is added for each 100 cc. given. In this manner many of the students have aided in paying their way through college. Donors are also obtained through the medium of radio and newspaper advertisement. A Wassermann test is performed on the blood of all new donors and every three months on those known to us.

SUMMARY. 1. The effect on donors of bloodletting in 175 transfusions is presented.

2. Hemoglobin, red cells, white cells, blood plates, clotting time, volume index, vital capacity and weight were estimated before and after each transfusion.

3. Studies were made in successive transfusions. The average reduction of hemoglobin in males was 4 per cent and of red cells 300,000 whenever approximately 400 cc. were given.

4. The results of the estimation of clotting time, volume index, blood plates and vital capacity were indefinite and did not afford material from which conclusions could be drawn.

5. The average immediate loss of weight resulting from the donation of approximately 400 cc. was 0.5 to 1 pound.

6. All male donors except two gained from 1 to 13 pounds in weight.

7. Female donors were not as satisfactory as male donors. Whenever 400 to 500 cc. were donated an anemia developed more quickly in females than in males and the return to normal was delayed.

8. We suggest that 300 cc. be the amount for donation by females if several donations are contemplated except in emergency cases.

9. If but 400 cc. or less are donated male donors may be used four or five times at three- to five-day intervals without ill result to them.

10. If more than 500 cc. are donated the interval between donations should be lengthened and the number lessened, for we found that whenever amounts of 500 cc. or more were given at short intervals the donors noted marked systemic and symptomatic effects.

11. Thirty of the fifty donors weighed more than 160 pounds.

12. The tall, wiry, robust donor, between the ages of twenty and forty years, stood blood loss better than one of short stature or one tall but fat.

13. It was noted that the blood of some donors seemed to produce more favorable results than that of others.

14. Some 350 donors have been observed. When approximately 400 cc. of blood were donated an unfavorable result was noted in only 1 instance.

15. Six "lay" donors fainted "on the table" from psychic shock and the transfusions were discontinued because the blood flowed so slowly.

16. Donors are paid from twenty-five to fifty dollars for donations of 200 to 500 cc. of blood.

17. Wassermann tests are made before transfusion and at three-month intervals.

18. Many donors noted improvement in general health: acne and constipation were favorably influenced; there was an increase in weight in the majority and many noted a greater ease in performing their routine duties.

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DISCUSSION

Dr. Alfred Stengel: I would ask Dr. Jones has he ever seen any donor who has given small amounts of blood at reasonable intervals—I mean any male donor—who has suffered? I have, and therefore I ask the question, because two interns, one of whom was about thirty-one and unusally sturdy, the other one I should say had not been wisely selected and did not fall within Dr. Jones's very carefully drawn description of what donors should be. Both of these men suffered in ways such as he has referred to in cases of very large amounts of donation. That is, they became more or less debilitated, while not suffering in sense of a diminished blood count. They were not capable of performing their duties, though they had previously been able to do their work well. The same thing happened to two medical students. All of these cases I refer to were persons who never gave over 500 cc. of blood and whose donations were given at fairly long intervals, not anything like the short intervals Dr. Jones has noted. Of course, these may be exceptions, therefore I ask the question. It happens that I have seen also at least one case of an individual who gave several donations at not very shortly spaced intervals, who developed and was admitted to the hospital with a very serious form of anemia. Of course, it is hardly fair to introduce this case, because I do not know what the man's condition was before they took blood from him. He may have had, upon discriminating analysis, some beginnings of anemia when they took blood from him. I only know he was admitted to our ward in a very serious condition of anemia, suggesting pernicious anemia. The history was that it had followed three donations of blood at fairly long intervals. I think the very careful work Dr. Jones has done demands that we receive it without prejudice based

upon exceptional cases. At the same time experiences like these I refer to make one feel a little hesitant in going along as far as he goes. I should be unwilling myself to reduce a person from 96 to 68 per cent of hemoglobin by giving several transfusions of blood amounting to as much as 1200, 1400 or even as much as 2000 cc. of blood over a relatively short period of time. I haven't the absolute faith in blood counts that would make me believe that it is the sole criterion on which we shall judge the good or bad effects. I see too many people who have suffered from conditions which make one think of blood deterioration, or lack of quality of blood, whose blood counts do not indicate the condition sufficiently to make me think that the blood count is the all-sufficient criterion. I remember very well that von Noorden, speaking about chlorosis, pointed out that the blood counts sometimes did not altogether correspond with the clinical condition as he found it, and that his therapeutic efforts, his management, brought about a restoration of health which was not paralleled by changes in the condition of the blood. Of course, we must take that for what it is worth, but it agrees entirely with my own conception. I do not want to seem antagonistic to a very excellent piece of work, but at the same time this is a very serious matter we are discussing and I think it is only right to say exactly what one has in one's own heart.

Dr. Joseph Sailer: I have not personally known of a donor disturbed in any way by giving blood. I must confess that none of my donors have been studied, but none of them have made any complaints. Very often people ask me if it is dangerous to give blood; but if they are reasonably healthy I have always told them that it is not. I agree with Dr. Stengel that blood-counts are uncertain. We get better results if they are done by the same person, with the same instruments and under approximately similar conditions.

Dr. Herbert Fox: Dr. Jones did not raise the question of immune donors, but I wonder whether he would mind telling us whether he has any data showing the difference between healthy donors and immune donors? I venture to think there might be some information in regard to the response of bone-marrow in immune as against healthy conditions.

Dr. Hobart A. Hare: I would ask Dr. Jones whether any blood-platelet studies were carried on side by side in connection with the other blood counts?

Dr. Jones (closing): Regarding the remarks Dr. Stengel was kind enough to make, I do not know what criteria we depend upon to designate change in the blood elements following donation, unless we rely on our blood counts and symptoms. We recognize the marked variation in blood counts, as Dr. Sailer pointed out, when several men make the studies. Our work was performed by three men: we made all the studies personally and used the same apparatus with as much care as is possible to use in estimating red blood-cell counts.

There is a distinct difference in effect on donors when 400 cc. of blood and 500 cc. of blood are donated. When we use 500 cc. of blood we are getting into the large transfusion class. I have based my presentation this evening on the results obtained with smaller donations, 400 cc. or less, and on those standards conclusions are drawn. Furthermore, I have noticed that if we take 500 cc. to 600 cc. of blood that the donors are more easily affected. Dr. Stengel mentioned that his donor may have given 500 cc. at each donation. If this latter amount was used, I think it might explain the production of an anemia. In my experience with donors I have never seen untoward results from the use of small donations from male donors. That experience, as stated before, is based on 3000 transfusions with approximately 450 donors.

In regard to Dr. Fox's question: I have not had enough experience with immunized donors to draw any conclusions. Only two immunized donors have come under my observation. I do not know that they react in any way different from others.

The blood platelets studies, Dr. Hare, were made along with volume index, vital capacity, etc. We were unable to draw conclusions from those studies which would be of value in this report.

SUBACUTE ENDOCARDITIS SIMULATING MENINGITIS*

By JOSEPHUS T. ULLOM, M.D.

Frank emboli of the brain are not uncommon in endocarditis of the acute or subacute variety, and are usually manifest by a hemiplegia, monoplegia or a paralysis of a cranial nerve, but emboli producing symptoms of meningitis have but rarely been reported. Osler,[1] in an article upon subacute endocarditis, speaks of cases with predominant meningeal symptoms, but does not go into detail.

P. Lereboullet and J. Mouzon[2] report a case of subacute endocarditis, or as the French call it, prolonged infectious endocarditis, with meningeal symptoms. Their patient had a severe headache, photophobia, a transitory left-side hemiplegia, and a lumbar puncture gave a spinal fluid under pressure with a cell count of 50. The Wassermann reaction in the spinal fluid was positive, but arsenical and mercurial treatment did not help. After five months' illness the patient died, and at the autopsy the typical lesions of subacute endocarditis were found, with a small hemorrhage on the external aspect of the left frontal lobe. They were a little at a loss to explain the meningeal symptoms. They refer to a similar case reported by a colleague, M. Claude, where there were 50 cells in the spinal fluid, and at the autopsy there was found softening at the base of the brain.

Cabot,[3] in his book, *Facts on the Heart*, refers to the case of a man, aged twenty-one years, who had rheumatism at twelve years, with a subsequent mitral lesion. He had an acute illness with temperature and suddenly developed a left-side hemiplegia with stupor. His neck was possibly slightly stiff; there was a positive Kernig and Babinski. Lumbar puncture gave a pearly fluid showing 860 cells, 70 per cent polymorphonuclears, 30 per cent lymphocytes and no organism. There was bilateral spasticity, with a very spastic, flexed, left arm and some spasticity of the right arm with some voluntary motion. The clinical diagnosis was chronic endocarditis, acute endocarditis, hypertrophy and dilatation of the heart, cerebral

* Read January 4, 1928.

embolism and abscess and acute meningitis. The patient died the day after admission and the autopsy showed edema of the pia but no definite meningitis. The left cerebral artery was solidly plugged and the anterior half of the brain, especially on the right side, showed marked softening and disintegration. There was no definite meningitis, although it was quite likely that the embolus was infected. The pathologist was unable to explain the pus in the spinal fluid, but thought it might have come from the disintegrated brain tissue. The heart showed chronic and acute endocarditis.

F. Janney Smith and Daniel M. Brumfeil[4] reported a case of a white man, aged thirty-six years, with a subacute endocarditis involving the aortic valve. He developed in the hospital photophobia, stiff neck, severe occipital headaches, positive Brudinski sign and equivocal Kernig sign. Lumbar puncture showed an opaque fluid with a cell count of 2400, with 90 per cent polymorphonuclears. In spite of the fact that they were not able to demonstrate the meningococcus, they administered several doses of antimeningococcic serum, and within ten days the fluid became clear with a cell count of 45. Blood cultures demonstrates Streptococcus viridans. The patient improved, left the hospital, suffered afterward a hemiplegia, gradually failed and died after an illness of approximately ten months.

Libman[5] speaks of meningism as "a much neglected but valuable symptom of subacute bacterial endocarditis, of all degrees of severity in the infectious period."

Vaquez,[6, 8] in his work on *Diseases of the Heart,* speaks of meningeal form of acute endocarditis and says it is distinguished by a predominance of cerebral symptoms, headache, pain in the spine, stiffness in the neck and vomiting.

Fiessinger and Janet[7] speak of a patient with endocarditis who was under observation six weeks. He had a double aortic lesion, headache, photophobia, no rigidity of the neck muscles and a very slight Kernig. A lumbar puncture showed a clear spinal fluid with 32 cells. Blood culture was positive. Autopsy showed lesions at the aortic valve and a congestive type of meningitis.

During the summer of 1926 I saw a patient for a colleague who was out of town. This patient was a woman, aged forty-five years, who had a loud mitral murmur which she had had since childhood. She had been treated for pyelitis, had improved and when I saw her was afebrile. She complained of weakness and malaise. She

suddenly developed a severe headache, vomited, and developed stiff neck, photophobia, positive Kernig and Babinski. She did not lose consciousness, but was very quiet and desired to be left alone. After some days these symptoms passed away, to recur in ten days, this time with a transient paralysis of the left arm, and the left pupil was larger and more sluggish than the right. She was unconscious for three hours and was afterward drowsy and very tired. She improved in a short time, left the hospital and died suddenly a few days later. She was not well studied, as she was under the care of three different physicians in a short time.

Shortly afterward, during the winter of 1926–1927, I attended a girl, aged seventeen years, who had a loud mitral murmur dating back to childhood, the result of rheumatism. She ran a slight temperature for a week, then had an embolus with a right-sided hemiplegia and aphasia. She lived for five months, regained her speech and some use of her arm and died of exhaustion. She had a constantly elevated temperature for the entire period of her illness.

Within a month of the time I first saw this girl, I saw two other girls with the same history, who developed high fever, and both had emboli in the brain with right-sided hemiplegia. Both the latter cases had innumerable petechia upon the arms and legs, and both died before they could be properly studied.

I mention these patients only to indicate that with this experience I may be a little biased in the diagnosis of the case I am about to report.

The patient whose history I wish to present was a boy, aged eighteen years, white, the third and youngest child. His father and mother are living and well; two older brothers are well; none dead. He had chorea and rheumatism at seven, followed by endocarditis. He had no other illness. His tonsils were removed subsequent to his rheumatism.

On March 25, 1927, he had a slight pain over his appendix, but did nothing about it. Three days later he came to my office complaining of slight pain and tenderness over the appendix. His temperature was 99.4°; pulse, 70; white blood cells, 14,000. The next day he was better, but on the third day his temperature was 100.6°; white blood cells, 10,700, and a surgical consultant felt that he was developing some acute infection and that while he might have a mild appendicitis this was not the cause of his symptoms. Physical examination at this time showed no abnormalities except a mitral systolic murmur of moderate intensity and an enlarged thyroid. This same day, March 30, while on the bed-pan, he felt a sudden numbness in his left arm and leg and shortly afterward was able to swallow capsules and food only with difficulty. These symptoms persisted and

the difficulty in swallowing became worse, and by the second of April he could not swallow at all. On April 2d we find him unable to swallow, speech slurring and thick so that one had to pay strict attention to understand him, no loss of consciousness, severe headache, photophobia, stiff neck, pain in the back, Kernig present, knee-jerks absent. The faucial muscles on the right side were paralyzed, there was some weakness of the muscles on the right side of the face, and there was moderate weakness of the right arm and leg. Temperature, 100°; pulse, 68; respiration, 18. Lumbar puncture showed 614 cells, 50 per cent lymphocytes, 16 per cent polymorphonuclears, 34 per cent ependymal; smear and culture were negative; spinal and blood Wassermann's negative.

In spite of the fact that the smear and culture were negative, it was thought best to administer antimeningococcic serum. This was done both intraspinally and intravenously until over 100 cc. had been given in the course of a few days. Pus continued in the spinal fluid, but no organisms were found.

The symptoms gradually improved, and by April 12 he was able to swallow, and feeding by gavage, which had been instituted, was abandoned. There was still paralysis of the faucial muscles and there was weakness in the right arm and leg. Speech was better and the stiffness in the neck and Kernig's sign disappeared. The heart murmur remained the same. Blood counts made during this period showed hemoglobin, 87 to 81; red blood cells, 4,600,000 to 4,210,000; white blood cells, 17,000 to 10,700. Differential: pulse, 79; lymphocytes, 12; large mononuclears, 3; transitionals, 2; eosinophiles, 3; basophiles, 1. Urinalysis: 1016, amber, flocculent; sugar, negative; albumin, faint trace; many hyaline casts and granular casts; many cylindroids; white blood cells, 2 to 3 to high-power field; occasional epithelium cell; urates; mucous threads.

In April 25 another lumbar puncture was done and showed fluid not under pressure with a cell count of 43. Lymphocytes, 92 per cent; polymorphonuclears, 4 per cent; endothelial, 4 per cent. Two blood cultures were negative. The patient refused any more.

From this time (April 25) until September 19, when he died, the patient ran a continuously elevated temperature, at times up to 103°, but usually not higher than 101°. He developed from time to time numerous petechiæ over the trunk and Osler's nodes upon the fingers. He also developed reddened, painful swellings in the forearm and leg, apparently of embolic origin, which would last for a few days and then disappear. The embolic phenomena were associated with a heightened temperature, usually up to 103°. The paresis in the right arm and leg entirely disappeared; he could talk naturally and swallow perfectly. There were never any cardiac symptoms nor any decompensation. He complained a good deal of pain in the lumbar region, at the sight of the lumbar punctures. His spleen was never frankly palpable. He had no sign of emboli in the spleen or kidney. At times the murmur seemed louder than at others.

Despite the fact that we had a negative blood culture, no enlargement of the spleen and no cardiac phenomena other than the mur-

mur, I believe that we are justified in making a diagnosis of subacute endocarditis with cerebral embolism. The patient's history of rheumatism and chorea, the cardiac murmur, the prolonged fever and the embolic phenomena convince me that this diagnosis is correct. In Osler's masterly presentation of this subject he emphasizes the fact that with a history of rheumatism, a cardiac murmur, a prolonged temperature and embolic phenomena, such a petechiæ and the nodes that bear his name, the diagnosis is almost certainly subacute endocarditis.

A positive blood culture, of course, clinches it; but Osler had positive cultures in but 3 of 10 cases reported. Malaria was looked for and excluded by failure to find the organisms. There was never any symptom to make one think of tuberculosis.

At the beginning of this illness two other diagnoses were offered. The first one was meningitis. This seemed almost surely correct with headache, photophobia, stiff neck, positive Kernig, irregular paralyses and 600 cells in the spinal fluid. But no organisms were found in smears or cultures or inoculation and after a lapse of two weeks the symptoms ameliorated decidedly. Had it been any other form of meningitis but that due to the meningococcus the patient would almost surely have died. Had it been the latter, we almost surely would have found the organism.

The second diagnosis was epidemic encephalitis. This protean disease is at times very difficult to recognize, being oftentimes diagnosed when the symptoms and signs are bizarre. But a triad of symptoms commonly characterize this disease, namely, fever, somnolence and ophthalmoplegia, whatever other symptoms may be present, and of these we have but one, "fever." True, there was a very slight droop of the right eyelid noticed, but absolutely no somnolence and no double vision, which I believe are almost *sine qua non* for the diagnosis of this disease.

I shall not attempt to discuss this phase of the matter further, but leave it to my colleague, Dr. Weisenberg:

"There is one other possibility which has not been mentioned, namely, aneurysm of a cerebral artery. The French writers speak of 'arteria lectasia,' which may occur in endocarditis as a result of the projection of débris from the heart valve against the arterial wall. They may involve any of the peripheral arteries. They form very rapidly and may persist without change or recede slightly, according to Vaquez.

"Friedman,[9] in Cecil's *Medicine*, speaks of aneurysm of the cerebral arteries as a result of embolism of the vessel wall. They are very small and not due to syphilis. Rupture or oozing may take place. In oozing, according to this author, signs of meningeal irritation may take place, such as stiff neck and a positive Kernig. Usually the cell count is increased, and the spinal fluid is usually slightly bloody or yellowish, due to derivatives of the blood pigment. He says that aneurysm of the basilar artery exerts pressure chiefly against the pons, medulla or peduncle. With such a lesion the patient usually experiences pain in the occipital region and difficulty in moving the head. Compression of the pons may be evident, with symptoms of alternating subacute hemiplegia or bulbar paralysis. Manifestations of irritation or paralysis are sometimes referable to the individual cranial nerves (fifth to twelfth). In aneurysm of the basilar artery, hemiplegia shifts from one side to the other, without ever disappearing completely, until finally the condition becomes diplegia or paraplegia.

"I do not believe, however, that we were dealing here with an aneurysm of a cerebral vessel, although it is certainly a possibility. It is likely that the lesion, whatever it was, embolus or arterial ectasia, was in the basilar artery or a branch. The numbness on the left side, followed by the paresis on the right, the difficulty in speech and deglutition, all point to a lesion in this neighborhood.

"Just how the symptoms of meningitis were produced is not clear, unless we have oozing from an aneurysm. There is no doubt in my mind that this patient suffered from subacute endocarditis. The subsequent course of the disease, the prolonged fever, the petechiæ, the Osler's nodes and the other embolic phenomena, with the almost complete disappearance of the neurological phenomena, force me to believe that the disorder was primarily cardiac and not meningeal or cerebral."

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DISCUSSION

Dr. David Riesman: I had the privilege of seeing this patient with Dr. Ullom. The case was a most peculiar one and not easy of analysis. In addition to well-defined cardiac disease he had nervous symptoms that suggested focal lesions. Speech was slurred. The right eye showed ptosis, and there was also, according to my records, a slight nystagmus present. Both forearms were wasted; the right hand was weaker than the left; sensation was diminished over the left forearm and leg and left side of abdomen. The abdominal reflex w s absent on both sides. There was no Kernig sign, no ankle clonus and no Babinski reflex. There was one petechial spot on the right lower eyelid. I felt that the patient had had a meningoencephalitis, possibly also a myelitis involving the anterior horns supplying the arm muscles, but that the dominant condition was subacute endocarditis. A negative blood culture does not militate against the diagnosis of subacute endocarditis.

The most interesting feature in this case is the association of definite focal nerve lesions with a slowly developing endocarditis. One might think at first sight of two independent diseases, but it is quite probable that the brain and cord lesions were of an embolic character, the emboli arising in the heart.

Dr. Ullom is to be congratulated upon his analysis of the case. It seems to me it is the only possible one. On account of its exceptional character and the unusually clear way in which it is reported, the case will, I think, be widely quoted in the literature.

Dr. Alfred Stengel: I saw this patient on one occasion, and wish also to refer to another because it seems to fall into Dr. Ullom's classification. He referred to some French authority who cites a meningeal form. As to meningeal manifestations, or meningismus, this is a common manifestation in acute malignant endocarditis, but in this subacute form it is rare and I would place it in the same category as a complicating pericarditis, which should usually suggest the diagnosis of malignant (acute) rather than subacute endocarditis. It so happens I have just had under my care a patient sent home after being in a hospital under my charge for about six weeks, which illustrates this unusual type which Dr. Ullom has reported. A man of superb physique, one of the world's great athletes, came to me telling

me he had been queerly ill at the home of his brother. The nature of his illness was obscure, but finally the attending physicians seemed to lo ate trouble in the left chest, which was needled and a small amount of clear fluid removed. Shortly after this time he came to me with uncertain sounds of pleurisy at the base of the left chest, mild fever and leukocytosis. I had examined this man in his college days, twenty-five years ago, and at various times since then. There was nothing abnormal about his heart and I had not the slightest suspicion of a heart lesion. He came to hospital and had an *x*-ray examination of his chest, which showed vague shadows at the left base where I had found uncertain physical signs. He had very slight fever and was scarcely ill enough to remain in the hospital. A day or two later, however, he developed a fairly marked fever outside, and returned to the hospital. I gave him quinine, 3 grains three times a day. After he had had perhaps 9 grains of quinine, almost complete deafness developed and the patient became "queer in the head," with a little droop of his eyelid and a stammering, stuttering speech which we had never observed before. We naturally suspected the quinine at first in spite of the small amount given, but after it was discontinued the mental symptoms persisted, though the deafness was somewhat less marked. A few days after that Dr. Spiller saw him, and on account of certain suggestive symptoms considered a diagnosis of undeveloped paresis. The Wassermann of blood and spinal fluid was negative. The next development was a little numbness and pain in his right hand, which he had never mentioned to me. Apparently this had occurred suddenly. On going into his room, and, not having been told of the pain in his right arm, taking him by the hand, he said, "Oh! that hurts." On feeling for his pulse I found he was pulseless. He never regained any pulse in his wrist and the hand was almost completely useless. No pulse could be detected in the right brachial, but pulsation was felt in the axillary at the upper part of the axilla, just below which a tender swelling of the artery could be made out. I immediately listened to his heart and discovered a pronounced aortic diastolic murmur which had never been discovered before. He developed petechiæ. He had three positive blood cultures and all showed Streptococcus viridans. He has been sent from the hospital to his home. This case falls in very well with the case Dr. Ullom has reported, so far as the cerebral complication is concerned. It is the first experience I have ever had of pronounced cerebral symptoms with subacute endocarditis. Of course, I exclude terminal cerebral symptoms.

I want to allude to another thing Dr. Ullom brought out—the development of aneurysm. This experience I have had once and have never seen mentioned in any literature. A young man under my care, with subacute endocarditis, developed an aneurysm of the right femoral artery, which became the size of a good-sized plum. I asked Dr. Deaver to see him, thinking some surgical measures might become necessary, but after some weeks the aneurysm disappeared absolutely and the man lived until some months later, when he died with all the manifestations of endocardial disease. The aneurysm gradually shrank. I have never read or heard an account of one of these aneurysms developing in the course of the disease and spon-

taneously disappearing. I recall, however, seeing Osler autopsy a man in whom there were found several aneurysms of the aorta which were about the size I have just described—one of them at the arch, two or more in the thoracic aorta, filled with partly organized clot. He pointed these out as aneurysms in a rather satisfactory healing condition and in connection with the case called our attention to the occurrence of aneurysm as complicating cases of infectious endocarditis.

Dr. Ullom's analysis leaves no reasonable ground for doubt as to the diagnosis. Pointing out the meningeal symptoms with this disease, I think, is quite worth while.

Dr. Joseph Sailer: I also saw the patient. Whether he had subacute endocarditis, I am not at the present prepared to say. I do not know where the line is drawn, but unquestionably something caused his death. Other manifestations in this case which have been brought out by Dr. Ullom are interesting. The inability to swallow is a very rare condition. It is not very common. I had one case in which Dr. Jackson was able to demonstrate that the patient had paralysis of the inferior constrictor of the pharynx. She was fed by a nasal tube. I do not know whether this is the only condition that gives rise to difficulty in swallowing. The number of cells in the spinal fluid might, of course, mean a good many things. A considerable number of cells in the spinal fluid is not uncommon. I had a man in the hospital last spring with very marked meningeal signs for a long time—Kernig's, stiffness of neck, 1300 cells in spinal fluid. He made a complete recovery. Subacute endocarditis is not a rare condition. I had a patient under my care for over two years with positive blood cultures of Streptococcus viridans. She is apparently well, although occasionally there is some fever and backache. She seems to be slowly recovering.

Dr. Hobart A. Hare: As the President completes his term of office this evening, he may be pardoned for entering the discussion. He was one of the galaxy that saw this patient and believes he was the first to see the patient in consultation. The history at that time was—Dr. Ullom will correct me if I am wrong—a schoolboy engaged in washing his automobile, recently given him by his father, came in feeling badly. That was the beginning of his illness. When I saw him a very few days later he had a single cardiac murmur. He had evidence of impairment of basal nuclei, had great difficulty in swallowing, speech was so indistinct that we could scarcely make out anything he said. He had some ptosis and was definitely lethargic. I made the diagnosis of encephalitis lethargica. At that time there had been no spinal puncture and I think no blood culture and the diagnosis had to be made solely on symptoms. I think quite likely this boy died of subscute endocarditis, but I think we should bear in mind that patients may have two diseases at once, and the fact that he did not have multiple murmurs, but only a single mitral murmur instead of multiple lesions, was not in favor of subacute endocarditis. Organisms producing encephalitis lethargica may, for all we know, produce subacute endocarditis.

Dr. Ullom (closing): I had the advantage of all the other gentlemen in that I followed the case to its conclusion. The diagnosis was very difficult. I do not think it was possible for any one to make a diagnosis early. During the month of June the boy had numerous petechiæ all over his body. Had we been able to get blood cultures at this time, no doubt we would have found the organism, but the patient had been punctured so much that he refused to have a blood culture.

THE PATHOGENESIS OF SCARLET FEVER AND ERYSIPELAS*

By FRANCIS G. BLAKE, M.D.

(From the Department of Internal Medicine, Yale University School of Medicine.)

In 1924 Dochez[1] introduced an antitoxic and antibacterial serum for the treatment of scarlet fever. This serum was prepared primarily to neutralize the specific toxemia of scarlet fever through its antitoxin content, but also with the hope that it might be of therapeutic value in controlling the septic features of the disease by virtue of its antibacterial properties. Shortly after this Dick and Dick[2] prepared a purely antitoxic serum for the treatment of scarlet fever. So far as one can judge from personal experience and from reports in the literature both of these serums, when equivalent amounts of antitoxin are used, are equally effective in curing the toxic phase of scarlet fever. Furthermore, both appear to exert a favorable influence on septic complications if these are not too severe at the time when the serum is administered, and both seem to reduce the incidence of septic complications in patients who have not developed them during the early toxic phase. As pointed out by Blake and Trask,[3] the beneficial effect of these serums with respect to the septic lesions would appear to be an indirect one. By neutralization of the toxin and cure of the toxemia the patient is placed in a better position to cure or prevent, by his own defensive mechanisms, the septic aspects of the disease.

In 1926 Birkhaug[4] reported that he had produced an *antitoxic* serum that was effective in the treatment of erysipelas. This serum was prepared on the basis of experimental studies which led Birkhaug[5] to believe that erysipelas is essentially a specific toxemia arising from a local focus of infection and comparable to scarlet fever in its pathogenesis.

While it is doubtless true that scarlet fever and erysipelas do possess some features in common, the clinical dissimilarities between them are, nevertheless, so striking and so numerous that it has seemed somewhat difficult to accept the view that the pathogenesis

* Read, February 1, 1928.

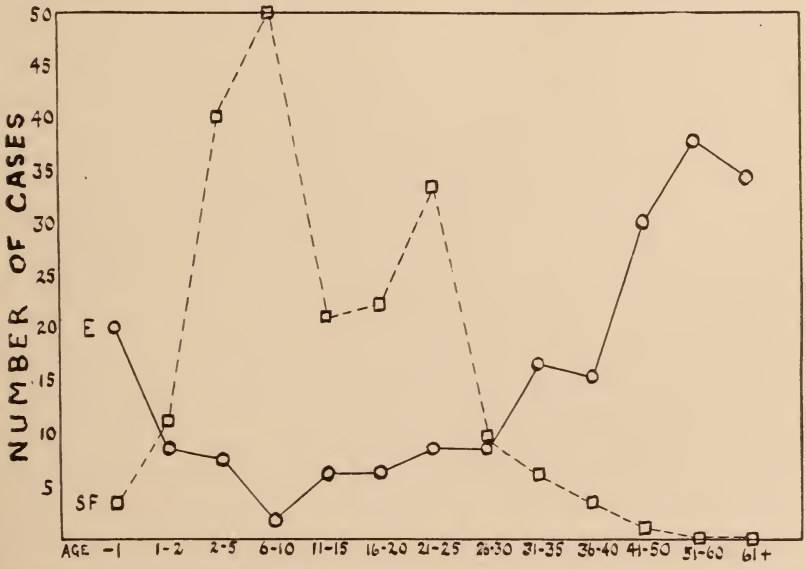
of the two diseases is in reality the same. Consequently, since the intelligent evaluation of any specific-serum treatment demands an understanding of the pathogenesis of the infectious disease in question, it has seemed to me that it might be profitable to present a brief comparison of the clinical features of scarlet fever and erysipelas and to supplement this comparison with the results of studies concerning their pathogenesis as a basis for the evaluation of antitoxin treatment in these two diseases.

Comparison of Clinical Features. *Source of Infection.* The source of infection in scarlet fever is exogenous, usually through contact infection, sometimes through carriers or infected milk. So far as known, it is not an autogenous infection. In erysipelas, though the source of infection is undoubtedly often exogenous, it is, nevertheless, very frequently autogenous through autoinoculation from an existing infection sometimes of considerable duration. Thus in 200 consecutive cases of erysipelas at the New Haven Hospital in at least 109 the erysipelas occurred as a complication of an existing streptococcus infection (follicular tonsillitis, 29; otitis media, 23; rhinopharyngitis and sinusitis, 33; abscesses, 21; septic sore-throat, 1; scarlet fever, 1); while in only 5 was there known contact (in 3 cases with erysipelas; in 1 with tonsillitis; and in 1 with scarlet fever).

Contributing Etiological Factors. Contributing etiological factors would appear to be relatively uncommon in scarlet fever. Burns, wounds, the puerperium and acute respiratory infections sometimes play a rôle. In erysipelas the reverse is true. Of the 200 cases of erysipelas whose histories were studied, 57 had a definite lesion of the skin at the site where the erysipelas started: in 16, abrasion; in 13, pimples; in 6, ulcers; in 3, burns; in 4, skin disease; in 2, insect bites; in 13, miscellaneous lesions. Doubtless, many of the others had similar lesions even though no note of it was made in the histories.

Age Incidence. It is a well-established clinical fact that the age incidence of scarlet fever and erysipelas is almost the reverse the one of the other. This is clearly shown in the chart, which shows the age distribution of 200 consecutive cases of scarlet fever at the New Haven Hospital as compared with the age distribution of the 200 consecutive cases of erysipelas. The second peak in the scarlet-fever curve (ages twenty-one to twenty-five) is due to the disproportionate number of nurses in the group, and it would probably not appear except for this fact.

Clinical Course. It has long been recognized that scarlet fever exhibits a specific, relatively short, self-limited toxic phase which is characterized by a specific lesion clinically observable in the exanthem, the enanthem of the soft palate and the strawberry tongue, and that this picture together with a local focus of infection, usually in the tonsils, and the general symptoms of toxemia constitute the essential phenomena of the disease. No phenomena comparable to the specific toxic features of scarlet fever are seen in erysipelas. In addition to the specific toxic phase, scarlet fever may exhibit a



Age distribution of 200 consecutive cases of scarlet fever (*S F*) and 200 consecutive cases of erysipelas (*E*).

septic phase of variable duration, due to invasion of the tissues by the streptococcus; but this is not an essential part of scarlet fever and many cases occur without it. On the other hand, this type of infection constitutes the essential feature of erysipelas, a spreading lymphangitis of the skin likewise of variable duration.

Acquired Immunity. With respect to the acquisition of an effective immunity following an attack, scarlet fever and erysipelas are again almost the reverse the one of the other. Second attacks of scarlet fever are very rare; second and even repeated attacks of erysipelas are of relatively common occurrence. In a series of 5000

cases of scarlet fever, McCollom[6] records only 10 second attacks, or 0.2 per cent. In the 200 cases of erysipelas in this study, 28, or 14 per cent, had had previous attacks of the disease (19, one previous attack; 5, two previous attacks; 2, five previous attacks; 1, "about seventy-five" previous attacks; and 1, "too many to remember"). With respect to the acquisition of immunity without an attack, it is now well established by means of the Dick test that approximately 85 per cent of all adults have acquired an immunity to scarlet fever. In the case of erysipelas we possess no comparable evidence, but the fact that the greatest incidence is in the later decades of life indicates that erysipelas differs conspicuously from scarlet fever in this respect.

The clinical differences, then, between scarlet fever and erysipelas are numerous and they are important to bear in mind in an analysis of the pathogenesis of the two diseases. The suggestion is clear that as an infectious process erysipelas is comparable not to the specific toxic or essential phase of scarlet fever, which makes it a clinical entity, but rather to the pyogenic or septic type of infection with Streptococcus scarlatinæ, which occurs not only as a complicating process in cases of scarlet fever, but also independently of scarlet fever in the so-called *scarlatina sine exanthemate* in persons immune to scarlet fever.

Studies on Pathogenesis. To understand the pathogenesis of an infectious disease requires not only a knowledge of the bacterial incitant and the methods by which it attacks the host, but also a knowledge of the means by which the host resists the infection or, if infected, brings about a natural termination of the disease, since it is the interplay of the parasite factors on the one hand and of the host factors on the other that determines the characteristics of the disease in question.

Bacterial Incitant. The bacterial incitant in both scarlet fever and erysipelas is now known to be Streptococcus hemolyticus. To establish this in the case of scarlet fever required the accumulation of experimental evidence over a period of thirty-eight years from the time it was suggested by Klein,[7] in 1885, to the final proof provided by Dick and Dick,[8] in 1923, through their transmission experiments in man with pure cultures of scarlatinal streptococci under conditions sufficiently rigid to exclude chance infection or the presence of an unrecognized filtrable virus. In the case of erysipelas it was established as early as 1882 by Fehleisen,[9] and has since been confirmed by numerous investigators.

Whether or not there exist two specific biological types of hemolytic streptococci qualitatively distinguishable from other hemolytic streptococci, which may properly be designated Streptococcus scarlatinæ and Streptococcus erysipelatis respectively, still remains uncertain because of much conflicting evidence. The most recent studies of Stevens and Dochez[10] suggest that most scarlatinal strains have common antigenic properties which serve to distinguish them, but that they are not all identical; also that the same is true of most erysipelas strains. Whatever the truth may be with respect to the immunological specificity of these organisms, it would appear to be of relatively little importance in the present discussion as compared with the facts concerning their pathogenic properties, and consequently it need not be discussed here. Knowledge of the pathogenic properties of the scarlatinal and erysipelas streptococci, on the other hand, is of the greatest importance. Of these the two of most significance would appear to be (1) the invasive and pyogenic property and (2) the toxigenic property.

Invasive and Pyogenic Properties. That Streptococcus scarlatinæ may be actively invasive and pyogenic is evident from the wide variety of focal and generalized suppurative processes, such as sinusitis, otitis media, mastoiditis, meningitis, adenitis and pyemia, caused by this organism in patients with septic scarlet fever. This is also evident from the fact that it may cause follicular tonsillitis, sinusitis, pneumonia, etc., in persons immune to scarlet fever, as recently shown by Nicholls,[11] Stevens and Dochez[12] and others. It is even more obvious that erysipelas streptococci must be invasive, since erysipelas is due to invasion of the skin by the organism, and equally obvious that they are pyogenic, since the same focal and generalized suppurative conditions that can be caused by scarlatinal streptococci may either precede or complicate erysipelas and be caused by the organism causing the erysipelas. Whether or not erysipelas streptococci possesses a more highly developed invasive capacity for the human host than scarlatinal streptococci is at present unknown. Although this might appear to be suggested by the fact that numerous cases of scarlet fever occur without obvious invasion beyond the superficial infection of the tonsillar crypts, while probably no case of true erysipelas occurs without tissue invasion, it would, nevertheless, be unsafe to draw this conclusion, since any apparent difference may depend entirely upon differences in host resistance rather than upon differences in microbic invasive-

ness. Animal experimentation, it is true, lends some support to the view that scarlatinal streptococci are relatively noninvasive, since it is well established that many highly toxigenic scarlatinal strains are comparatively avirulent for the usual laboratory animals, while preliminary experiments now being carried on by Mrs. Gallagher in our laboratory indicate that erysipelas strains usually possess a considerable degree of virulence. But it is well recognized that caution must be used in interpreting results in laboratory animals in terms of the human host. Consequently, although it is clear that both possess invasive and pyogenic properties, any conclusion concerning the relative invasiveness of scarlatinal and erysipelas streptococci must still await further evidence, even though on clinical grounds a highly developed invasiveness would appear less essential for the organism causing scarlet fever than for that causing erysipelas.

Toxigenic Property. That scarlatinal streptococci possessed a toxigenic property was suggested as early as 1893 by Bergé,[13] who thought that scarlet fever was due to a local infection in the throat with streptococcus, and the general symptoms of the disease were due, as in diphtheria, to the absorption into the general circulation of a soluble toxin formed by the streptococcus at the site of the local infection. Observations in support of this opinion were made by Gabrichevski[14] in 1907. He found that highly susceptible children inoculated with a vaccine of scarlatinal streptococci developed a general reaction with a rash indistinguishable from that of scarlet fever. He interpreted this as being due to a toxin, in view of the negative blood cultures found in rapidly fatal toxic cases of scarlet fever. Further evidence was provided by Mair[15] in 1923, in his studies on the Schultz-Charlton rash extinction test, in which he interpreted the blanching phenomenon as being due to the local neutralization of toxin by an antitoxin in the serum. Dochez,[16] also, held the same opinion, in view of the fact that guinea pigs in which he had established a local focus of infection with a scarlatinal streptococcus occasionally died acutely, apparently from a toxemia, since streptococci could not be cultivated from the blood or body cavities. In 1924, Dick and Dick[17] proved the correctness of this view by demonstrating a highly potent toxin in bacteria-free culture filtrates of scarlatinal streptococci. They accomplished this by showing that a minute amount of the filtrate caused a local reaction on intracutaneous injection in susceptible persons and that a larger

amount injected subcutaneously produced a general scarlatinal eruption. The specificity of these reactions was established by negative control tests in persons who had had scarlet fever and by neutralization tests with convalescent scarlet-fever serum. Later, in 1924, Trask and Blake[18] demonstrated the presence of a similar toxin in the blood and urine of patients in the exanthematous stage of scarlet fever. Since 1924 numerous investigations of the toxigenic activity of scarlatinal streptococci have appeared both in the American and foreign literature. In general these have shown that the great majority, at least, of all scarlatinal strains have the capacity for toxin production highly developed, 0.0001 cc. or less of the culture filtrate containing sufficient toxin to give a positive skin-test in susceptible persons, while the majority of nonscarlatinal strains are relatively poor toxin producers. Thus McLachlan[19] found that all of 98 strains of scarlet-fever streptococci possessed the capacity to produce a potent toxin active in a high dilution (1 in 1000), while of 32 nonscarlatinal strains 13 failed to produce a toxin active in a 1 in 100 dilution, 5 produced a toxin active in this dilution, 6 in a 1 in 250 dilution and only 8 in a 1 in 1000 dilution. Similarly, Szirmai[20] has reported that the great majority of scarlatinal streptococci produce toxins active in highly dilute filtrates, while the majority of nonscarlatinal strains fail to do so. Nicholls,[21] in our laboratory, has studied the toxin production of 40 strains of hemolytic streptococci isolated from the throats of convalescent scarlet-fever patients. In every instance 0.1 cc. of a 1 in 1000 dilution of the culture filtrate caused a positive skin-test in Dick-positive subjects. Recently we have been studying the toxin production of streptococci isolated from cases of tonsillitis, otitis media, septicemia, erysipelas, etc. Up to the present time we have found these nonscarlatinal strains to have the capacity for toxin production poorly or not at all developed. Kirkbride and Wheeler,[22] on the other hand, have not been able to find so marked a difference between strains from scarlatinal and nonscarlatinal sources. They report that 90.82 per cent of 109 strains from scarlet fever and 68.47 per cent of 111 nonscarlatinal strains produced "potent" toxins. It should be noted, however, that streptococcus culture filtrates which caused positive skin reactions in goats in as low dilutions as 1 in 10 were classified by them as potent, that 72 per cent of 75 scarlatinal strains produced toxins active for goats in dilutions ranging from 1 in 100 to 1 in 400, while only 41.33 per cent of 75 nonscarlatinal strains

produced toxins of equivalent potency, and of these approximately 25 per cent were obtained from patients who had had a known exposure to scarlet fever. In this connection it must be borne in mind that a considerable proportion of highly toxigenic strains from nonscarlatinal sources may actually be scarlatinal streptococci obtained from infections in persons possessing an antitoxic immunity and consequently not presenting the clinical picture of scarlet fever

Many points of interest concerning the nature, unity and mode of action of scarlatinal toxin still remain uncertain. While it appears to resemble diphtheria toxin, for example, in that it is a soluble substance given off into the surrounding medium during the growth of the streptococcus in culture or in the tissues of the host, and is antigenic in that it stimulates the production of a neutralizing antitoxin, it differs from it in that it is relatively heat stable, in the rapidity with which it apparently induces antitoxic immunity, and in its apparent lack of significant toxicity for the usual laboratory animals and for young infants, even though the animals and newborn infants possess no demonstrable antitoxin in the blood. In fact, there is a considerable body of evidence which makes it seem probable that it is not a true primary exotoxin, but is rather a soluble exo-allergen, if one may use that term.

In spite of these uncertainties it, nevertheless, appears well established that the essential phenomena of scarlet fever, which establish the disease as a clinical entity, are caused by the action of the soluble substance elaborated by scarlatinal streptococci, which, for convenience of terminology if for no other reason, is commonly called a toxin. The features of the disease which may be surely ascribed to the toxin are the enanthem, exanthem, strawberry tongue, the general toxic symptoms of the exanthematous stage (fever, rapid pulse, vomiting and psychic disturbances) and finally the desquamation. The evidence for this may be briefly stated: (1) subcutaneous injection of the toxin in susceptible persons has been shown, by Dick and Dick[17] and others, to cause a general toxic reaction accompanied by an exanthem indistinguishable from that of scarlet fever; (2) Blake and Trask[23] have shown that the toxin is present in the blood during the early toxic and exanthematous stage of the disease, and disappears from the blood with the fading of the rash even though septic complications are present and continue; (3) Blake,[24] Park[25] and others have shown that neutralization of the circulating toxin by antitoxin treatment causes a prompt disappear-

ance of the rash and general toxic symptoms even though the antitoxin may exert no direct curative effect on existing suppurative lesions.

In 1925 Birkhaug[26] reported studies on the toxin production of Streptococcus erysipelatis which seemed to indicate that this organism possessed a toxigenic capacity comparable to that of scarlatinal streptococci. He found that broth cultures of erysipelas streptococci uniformly gave toxic filtrates, which in dilutions of 1 to 1000 produced a skin reaction in susceptible individuals similar to a positive Dick test. Some filtrates were potent in 1 to 3000 to 1 to 5000 dilutions. He also stated that the toxin was present in the blood during the acute stage of erysipelas. We have endeavored to confirm these observations of Birkhaug, but up to the present have been unable to do so. Dr. Francis and Mrs. Gallagher have tested the filtrates of a considerable number of strains of hemolytic streptococci isolated by them from cases of erysipelas. In no instance has a 1 to 1000 dilution caused a positive reaction in normal individuals or even in patients in the early acute stage of erysipelas. In fact, it usually required a 1 to 100 dilution, and frequently even this has failed to induce a positive reaction. In one apparently very susceptible normal test-subject 1 to 200 to 1 to 500 dilutions of some strains have given a positive reaction approximately 1 cm. in diameter. Dr. Francis has also failed to find any significant evidence of a circulating toxin in the blood of patients with erysipelas in 29 cases studied. From these results it would seem, to us at least, that erysipelas streptococci rarely possess any considerable degree of toxigenic activity, and that such capacity for soluble toxin production as they may possess is in no way comparable in degree to that possessed by the great majority of scarlatinal streptococci and probably of little significance in the pathogenesis of erysipelas.

Host Susceptibility and Resistance. The immunity factors in the host germane to the present discussion are those which correspond to the pathogenic properties of scarlatinal and erysipelas streptococci discussed above, *i. e.*, antibacterial immunity and antitoxic immunity. Since they would appear to be more or less independent the one of the other, they will be taken up separately.

Antibacterial Immunity. Resistance to the invasive and pyogenic activities of hemolytic streptococci, though called antibacterial immunity, is in reality but vaguely understood. In the case of infections with Streptococcus scarlatinæ, two factors concerning it

seem fairly well established. In the first place it would appear to be independent of antitoxic immunity, and in the second place it seems not to parallel antitoxic immunity. That it may be absent in the presence of antitoxic immunity is evidenced (1) by the observations of Blake and Trask[23] that the pyogenic or septic phase of scarlet fever may persist long after the patient has developed an antitoxic immunity as shown by the termination of the toxic phase of the disease, the disappearance of toxin from the circulatory blood and the appearance of a considerable amount of antitoxin in the blood, and (2) by the not infrequent occurrence of pyogenic infections with scarlatinal streptococci in persons exposed to scarlet fever who, at the same time, give negative Dick tests and possess sufficient antitoxic immunity to prevent their developing scarlet fever even though severely infected with Streptococcus scarlatinæ.[11]

Whether or not an antibacterial immunity may be present in the absence of an antitoxic immunity is not known, since we possess at present no certain method of determining the presence or absence of antibacterial immunity; but it seems at least possible that this may be so, since it is a well-established fact that many Dick-positive persons though frequently exposed to scarlet fever nevertheless fail to contract the disease.

Concerning antibacterial immunity in erysipelas we are equally in the dark except for what little may be tentatively deduced from known facts concerning the age incidence of erysipelas and concerning recurrent attacks of the disease. From these facts it would seem not improbable, in the first place, that the period of adolescence is the period of highest antibacterial immunity. In this connection it is perhaps not without interest that the septic phase of scarlet fever is much less frequent in this period than in early childhood. In the second place, it is apparent that an effective and lasting antibacterial immunity is not necessarily, if ever, acquired following one attack of the disease.

It should be noted, however, that Birkhaug[4,5] takes a different view and correlates susceptibility and immunity to erysipelas with susceptibility and immunity to the toxic filtrate of erysipelas streptococci, and apparently considers antitoxic immunity rather than antibacterial immunity to be the essential mechanism of defense against the disease. To us this would seem somewhat illogical, since, on the one hand, it is well established that an effective antitoxic immunity to scarlatinal toxin does not of itself provide

an effective resistance to invasion and local tissue infection by Streptococcus scarlatinæ, and, on the other, it is clear that erysipelas is primarily a local tissue infection irrespective of whether a specific toxemia comparable to that of scarlet fever is superimposed upon this tissue infection or not.

Antitoxic Immunity. Since it seems clearly established through the studies of Gabrichevski,[14] Dick and Dick,[17] Dochez[1] and others that the soluble toxin produced by scarlatinal streptococci is responsible for the characteristic clinical phenomena of scarlet fever, susceptibility to scarlet fever should depend upon susceptibility to the toxin, resistance upon an antitoxic immunity. That this is so with two important exceptions seems to be thoroughly proven by the results obtained with the Dick test, and in the light of parallel studies of skin reactivity to the toxin and of the antitoxin content of the blood in the same individuals. It is now reasonably certain, through the accumulated reports of Dick and Dick,[27] Zingher,[28] Smith and Taylor,[29] Rosen,[30] Debré,[31] Sparrow,[32] Friedemann and Deicher[33] and numerous others, that the Dick test is a reliably accurate measure of susceptibility and immunity to scarlet fever. Trask[34] has recently tabulated the figures in the literature available through 1926: of more than 5000 individuals giving positive tests 129 had contracted scarlet fever, while of more than 4500 giving negative tests only 4 had later developed the disease. Further evidence is found in the close correlation of the percentage of positive tests at different ages and the known age incidence of scarlet fever. Finally, it has been shown, through the studies of Henry and Lewis,[35] Davies,[36] and Debré,[37] that with rare exceptions persons giving a negative test contain a measurable amount of scarlatinal antitoxin in the blood, while those giving a positive test possess little or no antitoxin in the blood, and that there is an inverse relation between the skin reactivity of the individual and the amount of antitoxin in his blood.

The first important exception, as originally shown by Cooke,[38] is in the case of newborn and very young infants, practically all of whom give a negative skin-test, even to large amounts of toxin, irrespective of whether they have a passively transmitted antitoxic immunity or not. The significance of this observation is considerable, since it would appear to indicate that susceptibility to the toxin, which on the average does not reach its highest point until sometime in the second year of life, is an acquired susceptibility in the nature

of an allergic reaction rather than an inherent susceptibility to a primary poison. If this view is correct, a negative Dick test in early infancy signifies that the insusceptibility of the infant is due to a lack of sensitiveness rather than to the presence of an antitoxic immunity.* Although a negative Dick test, with the exception just noted, indicates the presence of antitoxic immunity and also appears to indicate an effective immunity to scarlet fever, it nevertheless should be reëmphasized here that it does not measure antibacterial immunity nor does it indicate resistance to focal or generalized pyogenic infections with scarlatinal streptococci.

The other exception is in the case of positive reactors. It is, of course, well known from clinical observation that persons giving a positive Dick test may be frequently intimately exposed to scarlet fever and still not contract the disease. It seems not improbable, therefore, that a positive test, though indicating susceptibility to the toxin, does not necessarily indicate susceptibility to infection, a point of view which has been emphasized by McEntee.[39] On the other hand, infection having occurred, a positive reactor will almost certainly develop scarlet fever. It would obviously be of interest to know whether resistant positive reactors are also highly resistant to Streptococcus tonsillitis, for example, but no data seem to be available on this point. Antitoxic immunity then, with the exception noted, would appear to be an essential part of the mechanism of resistance to scarlet fever. That it is, likewise, an essential mechanism for recovery from the disease is shown by the frequently confirmed observations that convalescent scarlet-fever patients in most instances rapidly become Dick-negative and exhibit measurable amounts of antitoxin in the blood, and by the demonstrated effect of antitoxin in cutting short the toxic phenomena of the exanthematous stage.

Observations concerning a possible antitoxic immunity in the case of erysipelas are comparatively few, apart from those recorded by Birkhaug.[4,5,26] He has reported that in normal individuals tested for skin sensitiveness, 21 per cent of 272 school children ranging in age from seven to seventeen years, and 27 per cent of 135 hospital patients (other than those with erysipelas), of ages from eighteen to seventy-two years, gave positive skin reactions to one skin-test dose of toxin. The presence or absence of a neutralizing antitoxin in the

* It is of course understood that approximately 85 per cent of newborn infants born of Dick-negative mothers have a temporary passive antitoxic immuniy.

blood was not determined. There would appear to be no significant correlation between these figures and the usual age incidence of erysipelas. In studies on patients with erysipelas, however, Birkhaug has reported that 18 patients gave positive reactions to one S. T. D. of toxin on admission to the hospital and that when convalescence was established the skin-tests became negative. With the disappearance of skin reactivity a neutralizing antitoxin appeared in the patient's blood. Francis,[40] working in our laboratory, has carried out similar studies but has been unable to confirm Birkhaug's results. In fact, he has found exactly the opposite. Of 30 cases of erysipelas skin-tested at intervals throughout the course of the disease only one reacted to 1 S. T. D. of toxin during the early acute stage; 6 reacted to 3 or 5 S. T. D. but not to less; 2 more reacted to 10 S. T. D. but not to less, and 17 failed to react even to this large amount and 12 were nonreactive even to 30 to 50 S. T. D.; 4 were not tested early. With the progress of the disease to convalescence, instead of becoming less reactive, the majority of the cases became more reactive. Furthermore, in 19 of 27 cases studied, a neutralizing antibody was already present in the blood in the early stage of the disease and, strangely enough, this was no longer demonstrable with two exceptions later than four days after recovery. These observations suggest that antitoxic immunity plays little or no rôle in resistance to erysipelas or in the mechanism of recovery. As pointed out by Francis, it would seem probable that an entirely different mechanism, possibly of an allergic nature, is concerned.

Summary. Although much still remains uncertain concerning the pathogenic properties of scarlatinal and erysipelas streptococci, and even more concerning the host factors of susceptibility and resistance, particularly with respect to antibacterial immunity, it would, nevertheless, seem probable on the basis of the observations now available that the pathogenesis of scarlet fever is as different from the pathogenesis of erysipelas as their clinical dissimilarities would lead one to suspect, and likewise that the mechanism of recovery in the two diseases is equally dissimilar.

In the case of the well-defined clinical entity called scarlet fever, it would appear that the occurrence of the disease depends primarily upon the infection of a toxin-sensitive or allergic host possessing little or no antitoxic immunity with a hemolytic streptococcus characterized particularly by a highly developed toxigenic capacity, but

also possessing invasive and pyogenic properties against which the host may be highly or little, though never completely, resistant. The pathogenesis of the essential phenomena of the disease represented clinically by the early toxic and exanthematous stage may be ascribed to the action of the toxin which is absorbed into the blood from the local focus of infection commonly situated in the throat. The pathogenesis of the septic phenomena which are quite unessential though frequently present in scarlet fever, may be ascribed to the invasive and pyogenic activities of the bacterial incitant in a host possessing relatively little antibacterial immunity.

In the case of the equally well-defined clinical entity called erysipelas the picture would appear, according to Birkhaug, to be quite similar to that in scarlet fever, but in view of our own studies we are unable to concur in this conception of the pathogenesis of the disease. To us it would seem more probable that the occurrence of erysipelas depends primarily upon the infection of a host possessing a partially or sometimes completely ineffective antibacterial immunity with a hemolytic streptococcus characterized by well-developed invasive properties. That the organism may also possess some toxigenic capacity seems clear, but that this pathogenic property plays any significant rôle in the phenomena of erysipelas appears doubtful, when it is found that the large majority of patients with erysipelas possess no significant reactivity to the toxin in the early acute stage of the disease, no demonstrable toxin in the circulating blood, and, in fact, already possess an antitoxic immunity as evidenced by the capacity of their serum to neutralize the toxin. The pathogenesis of the essential phenomena of erysipelas, like that of the septic stage of scarlet fever, may be ascribed to the invasive rather than to any specific toxigenic activity of the bacterial incitant in a host lacking a completely effective antibacterial immunity.

Recovery from the toxic phase of scarlet fever clearly depends upon the development of antitoxin by the host. Recovery from the septic phase is not directly effected by the development of antitoxic immunity, and, though perhaps indirectly assisted by it, depends upon some other mechanism at present not fully understood but often called antibacterial immunity. Recovery from erysipelas would appear to be comparable to recovery from the septic phase of scarlet fever and not to depend upon the development of an antitoxic immunity.

Antitoxin treatment in scarlet fever should be effective in curing

the essential toxic phase of the disease and it has been found to be so. On the other hand, there is no reason to believe that it should be effective in the late septic stage, and, in fact, it has been found to be of no demonstrable therapeutic value after the early toxic stage has passed. If the conception that erysipelas is comparable to the septic rather than to the toxic stage of scarlet fever is the correct one, it would appear to offer little basis for the view that antitoxin treatment should be of particular value in this disease.

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DISCUSSION

Dr. Hobart A. Hare: It is not appropriate that this very excellent piece of research work should be passed by without being dignified by a general discussion. The difficulty lies in the fact that the clinician, in distinction to the laboratory man, is unable to follow step by step every detail shown in the charts, yet these are the points which the investigator considers most important. One point which struck me as being of peculiar interest was the discussion of the fact that in scarlet fever the toxin appears followed by the antitoxin, and then in severe cases that there is a secondary "septicemia," as the author calls it, which seems to indicate one of two things: either that the microörganism producing so-called scarlet fever has the ability to produce two toxins, one of which is represented by rash and the development of an antitoxin which neutralize its and then a secondary toxin which produces the so-called septicemia, unless the author of the paper wishes us to consider that the septicemia is a secondary infection, what Osler and Flexner called terminal infection, superimposed on the primary. Another point of particular importance to clinicians lies on what was said in regard to erysipelas. I have felt all along that antitoxic serums for erysipelas do not promise very much for two reasons: one is that erysipelas is a much more moderate disease than it was some years ago; another is that there are cases of very widespread distribution of the erysipelas rash with very slight systemic symptoms. I have seen cases in which the rash extended from back of neck to the heels, and yet at no time was the patient nearly so ill as in some other instances in which a relatively limited area of inflammation which has been phlegmonous caused marked toxemia. In regard to scarlet fever and use of antitoxin artificially prepared, I believe the result in hospitals that deal with these cases shows pretty clearly that many cases will get well without antitoxin and many others suffer from serum sickness to the extent that it is a question whether it is not better not to give antitoxin. It is a cause of regret to me, and I doubt not to other Fellows of the College, that some of the charts could not have remained on the screen, for then with our eyes fixed on the screen I could discuss the subject point by point. Finally, let me say that I consider I am somewhat guilty of temerity in attempting to discuss a paper which involved long periods of work and which has evidently called forth the very best in the reader's ability as a bacteriologist and clinician.

Dr. Blake (closing): There is one point in Dr. Hare's discussion I would like to say just a few words more about and that is the development of the septic phases in scarlet fever. I think it is thoroughly established that the septic processes are due to the same streptococcus that causes the scarlet fever. The nature of the general toxemia—that is fever, rapid pulse and so on—associated with infections of that type is still, I think, a matter for further investigation. There are a great many theories concerning it. The most prevalent theory at the present time is that it is an allergic type of reaction to bacterial protein. As a matter of act, I think we do not know

at the present time definitely what the nature of the poison, or poisons, may be that causes the general reaction in any kind of sepsis. The major point that comes out is that the scarlet-fever streptococcus has two very distinct and quite separate methods of attacking the host: one which produces the disease scarlet fever, that is, elaboration of toxin and its dissemination throughout the body; the other, the capacity to invade tissues and cause inflammatory reaction. We talk loosely about the methods of defence being antibacterial, and we assume that the methods of defence are partly humeral, by which antibacterial substances exercise their immunizing properties; but we are really very ignorant about the exact method of recovery.

ORGANIC CHANGE AND DISTURBANCE OF FUNCTION*

By THOMAS McCRAE, M.D., D.Sc., F.R.C.P. (Lond.)

This title might serve as the text for many addresses on widely varying aspects of the subject, for the relationship between organic change and function has been and may be discussed from various angles and in many ways. But tempting as it is to consider the many relations of these subjects, it is not my intention to enter into the points of agreement or controversial aspects of many of the problems, but rather to discuss our attitude to the relationship of organic change and disturbance of function. This concerns every one who is interested in the study of disease in some part or other of his work. The relationship between the two is manifold and they interlock in many ways, but my object is to consider more particularly the views which we hold to them as teachers and practitioners of medicine.

You will note that I do not say functional disturbance but disturbance of function. This was done with design, for the word functional has been unfortunate in its employment. For example, we speak of functional nervous disturbance, meaning a condition in which no organic change is demonstrable, and of functional disturbance of the heart, sometimes meaning manifestations for which we can find no structural change responsible, but sometimes meaning a disturbance of function, such as in conduction, due to an organic change. It is evident that ultimately it may be found that there is an organic basis for all these cases.

My discussion of the topic is directed particularly to the attitude which we should try to take in our own minds to these deviations from the normal. It has been said that every man is born a follower of Aristotle or of Plato. To some extent it may be held that each of us was born with a mentality which has a tendency to take a stand with regard to the relative importance of organic change and disturbance in function. To some minds the study of organic change appeals more than investigation into a change in function. To others the main appeal lies in the study of function and its disturbance. Few of these, however, would go the length of one who

* Read February 1, 1928.

is interested particularly in the study of cardiac function by graphic methods. His opinion was that the newer graphic methods had completely done away with any need for study of changes in the heart muscle and the mass movement of blood. As he put it, "We have done away with all need for consideration of hypertrophy and dilatation of the heart. It is a waste of a student's time to direct his mind to these things." Of course, this is an extreme view and one which time will doubtless correct. Still it serves as an example, extreme though it is, of a tendency which seems widespread and which is most unfortunate for the development of clinical medicine and surgery. My intention is to try and show that the best development of a knowledge of disease requires a balanced effort to regard in proper proportion these two forms of change and that it is a mistake to magnify either one to the neglect of the other.

It may be of interest to look at the historical side for a few minutes, even if the survey has to be sketchy and hurried. Workers were naturally interested first in the normal structure and in studying anatomy, following which the serious study of changes in structure was begun. Probably from Harvey's discovery of the circulation of the blood came the greatest stimulus to the study of function and later to its disturbances. This stimulus did not exhaust itself, but has gone on with increasing force to the present day. Naturally many of the explanations of alterations in structure were incorrect and the effort to explain disturbances in function led to many fanciful ideas, such as those held by the iatrochemical school. The dead hand of historical authority was strong and exercised a powerful influence in retarding progress. It is not surprising that there was much error, and many wrong ideas regarding pathological and physiological processes did much to darken men's minds and confuse their ideas regarding the processes of disease. With Sydenham came some clarity of thought and an endeavor to study the phenomena of disease in a more systematic manner. But in his day, and after, there was no clear association between the changes in structure and the disturbance in function, which we may designate in other words as the clinical picture. The discussion as to the difference between a symptom and a disease runs through the disputes of those times.

The first efficient attempt to bring order out of confusion was in France, for the French mind tends to be logical. Many men contributed to this, but perhaps to Bichat is due a greater debt of

gratitude than to any other individual. The value of pathological anatomy to clinical medicine was thoroughly demonstrated. Pinel and Corvisart were breakers of the ground, but Laennec and Louis did much to gather the crop, and of their services to medicine it is not necessary to speak. These workers were more concerned with organic change and its relation to disease than with disturbance of function. With Broussais the pendulum swung the other way, and in his physiological medicine he dwelt more on functional disturbances than on anatomical changes. For his school the physiological (or perhaps we might say pathological-physiological) conditions were all important. We may say that, in the controversies which arose at this time, the battle was opened between those who inclined to regard structural change as all-important and those who saw principally the disturbance of function. This controversy has gone on in various ways ever since and promises to go on far into the future.

Turning to Germany, there are numerous examples of the varying trends of thought. Wunderlich, for instance, in his designation of "physiological medicine," had the intention of replacing anatomical study by physiological investigations. We know the tremendous development in experimental physiology which occurred in Germany and the great advances made as a result. But on the other side came the work of Virchow, dealing particularly with structural change, which to a large extent dominated medicine but not without opposition. Errors there were, such as the dualistic idea of tuberculosis and what we may describe as the dualistic conception of diphtheria, as well as the view that variola and varicella were one disease. So strong was the influence of unbalanced devotion to one or the other side that certain clinicians came to regard clinical medicine as the servant of physiology or pathology. But this was not universal; Naunyn especially was severe in his criticism of those who were unduly influenced by physiology. There was undoubtedly the tendency in many quarters on both sides to regard the important side of clinical medicine as being in the laboratory rather than at the bedside. Have we not heard similar criticisms arising in our own time?

It is tempting to dwell on the many controversies, but a few examples of the way in which error crept in may be cited. Perhaps none of them is more striking than that relating to tabes dorsalis. As a clinical entity, first described by Duchenne, its position seemed

established, but those who worshipped too exclusively at the shrine of disturbance of function disregarded the lessons of pathology and endeavored to associate it with other forms of ataxia, such as those due to cerebellar lesions. Much time and effort were required to establish a point which would never have been in dispute had men been able to look at change in structure and disturbance in function in proper proportion. To us, with the pathology and disturbance of function of this disease firmly established, such an error seems surprising and difficult of comprehension, but we no doubt are wandering from the truth in equally foolish ways if we but knew it, and will furnish similar examples to those who come after us.

But it must not be suggested that the insistance on the disturbance of function as all-important was not useful. It led to great advances, as, for example, in our views as to the importance of insufficiency of the heart muscle and of the motor power of the stomach. The difficulty did not result from any facts which were discovered as to disturbance of function, but from the lack of recognition that the problem had other sides.

If we survey the comparatively recent years we see that the tendency has been to study functional disturbances particularly, and this for many has resulted in a neglect of proper consideration of organic change. The experimental method has come more and more into clinical medicine. Nor can there be any regret that this is the case for it has tremendously increased our knowledge. But the study of change in structure has been forced into the background, and some would have it also that the interest in etiological diagnosis has suffered as well.

Possibly the best example of the effect of influences leading to an ill-balanced attitude to organic disease and disturbance of function is seen in the history of our knowledge of certain gastric disorders. The discovery of the stomach tube opened the way for new methods of investigation and new concepts of gastric disease. The earlier view that disturbances in gastric function, such as changes in secretion, were the result of organic changes, certainly in a large number of cases, was replaced by the idea that these were primary phenomena and soon they were regarded as disease entities. Some of us here went through this period and can remember when we held such views. Diagnoses of conditions, wrongly regarded as diseases, which represented changes in function were fashionable, and consequently the recognition of gastric diseases which had organic

changes fell into the background. Gastric carcinoma could hardly be disregarded, but gastric and duodenal ulcer was neglected to a considerable extent, more in some clinics than in others.

But this journey up a blind alley was not altogether lost motion, for with it emphasis was placed on ideas of the greatest importance. The view that a diagnosis of disturbance of function would reveal the earliest stages of disease was an important one. Emphasized at first, it later was given less attention, to be revived years later. That in itself was probably worth the lost time and effort.

Mention has been made of gastric ulcer and the history of the views regarding it and some mention of these is of interest in this connection. Following the work of Cruveilhier, about 1830, this disease was studied by the methods of the French school and the clinical picture drawn as completely as was possible at the time. When attention became directed more and more to the study of disturbance of gastric function, due to the introduction of the stomach tube, hyperacidity assumed more and more importance and took the position of a disease entity. The picture of ulcer became dimmer as it was overlaid by the newer representations of a supposed disease. In consequence ulcer became comparatively rare in the diagnoses of many clinics if not in the bodies of the patients. What corrected this error into which too great emphasis on disturbance of function had led many workers? It was the demonstration and study of organic changes by the surgeon. The erroneous views based on too much attention to disturbance of function and too little to organic change were corrected by the study of the structural changes brought into the field of actual vision. Later the use of the *x*-rays was added; this has its greatest value in the recognition of organic change. Gradually a more accurate attitude as to the relationship between organic change and disturbance of gastric function as regards ulcer and gall-bladder disease was established after many years of error.

The impression gained by the study of the history of these many movements with changes in medical opinion from time to time is that when the proper balance in the attitude toward organic change and disturbance in function was disturbed, confusion resulted and progress was retarded. The main road was forsaken for a side path and much retracing of steps was often required. This seems to have resulted in whichever direction the error was made, toward too much attention to organic change or to disturbance in function,

but it seems that the confusion has been greater when undue emphasis is placed on disturbance of function rather than when the same occurs with organic change. Changes in structure in many cases can be more positively determined and we are on firmer ground, but still there may be serious mistakes here.

Mention was made of our debt to the surgeon in correcting some errors. Perhaps an example may be obtained from certain phases of their work. Given a properly equipped individual who wishes to devote himself to surgery and asks for advice as to the best use of his time, I cannot answer for all surgeons, but I fancy that many, probably a great majority, would insist on a proper knowledge of surgical pathology. They would regard a complete study of organic change as an essential part of the training.

In what is said of pathology, I do not mean to suggest that the pathologist is concerned only with morbid anatomy. Far from it. Early or minute local lesions may be less easily recognized in the cadaver than in the living patient, largely because of the disturbances of function which point to their presence, but to admit this is to suggest the need for the more careful practise of gross and microscopic morbid anatomy. Modern pathology is not the study of pathological specimens alone, but of pathological processes. The pathologist should be a student of disease in all its aspects, cause, course and result. In doing this he may take over some of the functions of physiology. But this will not be done if the physiologists have their way. In Great Britain recently a strong breeze of criticism has been blowing on the workers in pathology and several physiologists have gone so far as to ask whether it would not be an advantage if physiology took over pathology entirely and pathology as a separate science ceased to exist. It may be said that physiology shows its value to medicine most when it takes over the study of disease processes, when it is employed in the study of the diseased body as well as of the healthy body. Physiology concerns itself particularly with the study of normal function, and in disease many of the phenomena are due to excessive, defective or perverted function. But the worker who approaches the study of disease as a physiologist need not expect to exhaust the study of a particular problem merely by attention to the disturbance of function. Witness heart-block, for example, in which any clear understanding which is to help the clinician and subsequently the patient must consider organic change as well.

This leads on to the question as to whether such subjects as anatomy, physiology and pathology should be taught with any idea that they may be useful to the student and physician or rather as "pure sciences" as they say. This is a large subject about which there is much difference of opinion. It is among the physiologists that the most extreme views are found. Some of them consider that physiology should never be taught with any idea of its being useful in the study of disease, but entirely for itself. They regard its association with medicine as a great handicap. There is no intention of suggesting that investigation should always be directed to producing results which will be "practical." No one can foresee what may follow from any discovery and the associations and applications that may result from it.

Some way or other the idea has gained ground in some quarters that the study of organic change is simple and unworthy of a great mind. When we consider what was accomplished by the late Sir Frederick Mott by his devotion to the study of organic change and how important his many contributions are, it is difficult to regard such an opinion as sound. But there is the danger that this view turns men away from the study of organic change.

May I repeat that in dwelling on the dangers of too great attention to disturbance of function, there is no suggestion or intention of being critical of the study of disturbance of function or of lessening its value. Far from it, for on the contrary we cannot overestimate its importance. My plea is for the necessity of watching our own attitude toward it, for history shows that it is easy to give it too great relative importance and forget or neglect organic changes.

What is the tendency of today? There seems little doubt that it is to exalt disturbance of function beyond its proper place in relation to organic change. This is not altogether a disadvantage, because it results in special attention being given to such studies and corresponding increase in knowledge. But if this knowledge is to pass into the daily work of the medical profession it must be used properly. Here seems an important duty of the medical teacher, that he should direct his students to a realization of the wisdom of a judicial attitude toward these two great forms of disturbance. Is there not a tendency in some quarters to give the student less opportunity of studying structure and its changes? Take anatomy, which is not a study of diseased structure but of the structure which is to be dis-

eased. A knowledge of the normal is necessary. Is there not a tendency in some schools to lessen the efficiency of the teaching of anatomy? Is the instruction sufficient for the student to learn the subject properly? If the study of structure is given less weight, is this a by-product of a disproportion between the attention given to organic change and disturbance of function? I state the question but do not answer it.

The study of morbid anatomy in some quarters seems to have fallen on evil days. I think we would agree that some pathologists have lost interest in this, if they ever had any. They are more serologists, for example, than pathologists in the older meaning of the term. Few perhaps would go the length of one pathologist to whom I said, in speaking of the teaching of this subject, that for undergraduate students the teacher of pathology should have a thorough knowledge of morbid anatomy. "What concern have I with morbid anatomy?" he scornfully replied: "That is elementary and any junior can teach it." If there are many like him there is justification for the opinion that in some places there is insufficient teaching of pathological anatomy. It made me wonder if this pathologist had ever listened to a proper demonstration of morbid anatomy. I can remember clinics of thirty years ago, but equally well some of the demonstrations in the dead-house. Some of us can recall morbid anatomy demonstrations by Sir William Osler or Dr. Welch which stand out in our memories as examples of how instructive such teaching can be. To be able to approach, even distantly, the perfection of such demonstrations might seem a worthy ambition for any pathologist. One difficulty is that this tendency to neglect morbid anatomy will go on increasing, for if the seniors give little attention to it the juniors have less chance to learn. The ultimate results are far reaching both for pathology and medicine.

It is interesting to speculate how important a knowledge of structural change is for the clinician. The question may be asked: Can any man be a great clinician without a good knowledge of morbid anatomy? My opinion is that he cannot. I quite agree that he cannot be a great clinician without a knowledge of disturbance of function—it is to be regarded as equally important. Part of my thesis is that the tendency of the present is to neglect the one and overemphasize the other. As the passing of time takes the figure of Sir William Osler farther into the past and we view him and his work from a greater distance, my feeling grows that his

knowledge of pathology was an enormous factor in his success as a clinician. Today many of the younger clinicians have little of a structural background of a knowledge of morbid anatomy; they have developed the functional side to a disproportionate degree. Whether such men can ever be great clinicians is a question which may well be asked. It should be needless to say that other qualities are necessary. But there is this comfort: If the pendulum has swung too far in one direction with time it will fall back nearer the center of gravity.

Some mention of the varying importance of the two factors is in order, for they interlock and interact in many ways. In many disease conditions their relative importance may vary from time to time. Take, for example, the presence of a foreign body in the air passages. If this lodges in the larynx, death may result promptly from disturbance of the respiratory function without any organic change of moment. The foreign body may pass into a lower lobe bronchus and remain there for some time, with resulting obstruction and abscess formation. The problem then is one of organic change primarily; disturbance of function is a secondary and minor matter.

In the study of the kidney and its disorders many advances have been made in our knowledge of disturbance of function and yet we have a long way to go before the problem can be considered as near solution. Consider how often the question of the relative importance of organic change and disturbance of function in chronic nephritis has to be answered at the bedside. It offers a nice subject for debate as to which is the more important. Some patients die, so far as we know, from the disturbance of function in the condition we term uremia, but many from the associated organic changes in the myocardium and arteries. To regard either side of the shield alone is to fail of comprehensive knowledge. The safest guide is he who sees both sides.

In certain forms of disturbance of the nervous system it is granted that with our present knowledge the importance of disturbance of function is infinitely greater than any structural change which can be demonstrated. It may be that in this field the finding of structural change may some time in the future change our views entirely. But here again overemphasis on function leads men away from the problem of investigation of organic change and tends to repeat the error of past generations. It is true that early or minute local

lesions may be more easily recognized in the living patient than in the dead body, largely because of the disturbance of function which they cause. But this should mean the more energetic study of organic change in the effort to identify such lesions.

There are many problems which concern the relationship between changes in structure and a resulting disturbance in function. In some cases this may be brought about through an intermediary structure. The sympathetic nervous system plays this part in many instances, but in the explanation of such problems there are many gaps in our knowledge. The subject of pain referred to the precordial region may be quoted. We know that there are many causes and that not infrequently the explanation in a given case is completely in doubt. Take, for example, those instances in males in which there are attacks of severe thoracic pain secondary to disease of the prostate and deep urethra, or at any rate associated with them. What is the mechanism at work in these cases? It is easy to theorize, but proof of any one explanation is difficult. Here lies a danger in diagnosis which may be emphasized. We too easily forget that the situation of pain or discomfort (which may be regarded as functional) may be far from the organic change to which it is due. In many cases the possibility of an organic condition being responsible is not even considered. At the risk of repetition the importance of this point should be emphasized. Some men are so full of the importance of disturbance in function that it is difficult for them to bring the consideration of organic change into their cerebral focus at all. In this lies a very real danger in diagnosis. What shall we say of the changes in Graves' disease? Does the greater importance belong to organic change or to disturbance in function? Probably the balance swings one way at one time and in an opposite direction at another. What is the essential etiology and pathology? Such a question is not to be answered by looking at one phase only; there must be a study of each side of the problem.

A great deal of emphasis has been laid on the importance of the early recognition of functional disturbance, based on the view that organic change in its early stages may manifest itself as functional disturbance when the organic change is slight and perhaps not possible of recognition. There is no doubt regarding the truth of this, but there is a certain danger if too much attention is paid to disturbance of function and organic change is allowed to drop out of consideration. I am sure that many of us have seen this shown

in a diagnosis of disturbance of cardiac function. It is felt that a diagnosis, say, of some delay in conduction having been made, nothing more is required. The matter is sometimes left there without any attempt to recognize what is behind the disturbance of function. It may not be necessary to say, but perhaps it is well to do so, that this is by no means universal. We should all be interested in disturbance of function, but we should not rest content with this. It is this danger to which attention is drawn. I believe that it is a great handicap in the training of many young clinicians.

It may seem unkind to dwell on special examples, but perhaps many of you will agree with me that some of those who have devoted themselves to the study of cardiac disorders are the greatest sinners in this regard. A recent example will perhaps best explain the point. An elderly man, rather stout, came complaining of some shortness of breath and irregularity of the heart. He brought very beautiful tracings, with an elaborate study of them. I quote his own words: "I want you to talk to me in words of one syllable and tell me what to do to be better. I saw Dr. X, but he seemed to be more interested in my tracings than he was in me. He talked a lot about my T-waves, whatever they are, and complexes, but I got nothing out of that. That may be interesting, but it did not do me any good. I want to be told what to do." In his interest over the tracings Dr. X had neglected to give him any advice and apparently had thought that his duty to the patient was fulfilled. An extreme example you may say, and no doubt it is, but it demonstrates how one-sided a man may be as a result of too great attention to part of a problem.

How this may be passed on to the student has been demonstrated to me in conducting clinical examinations for the National Board. A patient with dyspnea, emphysema, fibrosis of the lungs, marked engorgement of the veins of the neck and arms and an enlarged tender liver had been examined by a candidate. To the question, "Is there any evidence of change in the right heart?" he replied, "I do not know. I have not seen the electrocardiographic tracing." This was not so much his fault as that of his teachers. He had not been trained to recognize organic changes by using his own powers of observation.

Another example is shown in the diagnosis of what may be termed neurasthenia. In many cases this is a pure disturbance of function so far as any method of diagnosis at present enables us to say, but

in many instances it is the surface indication of organic change. Such common examples as this picture of disturbance of function being due to pulmonary tuberculosis are seen only too frequently. The same condition very often arises when disease of the thyroid gland is really responsible. These all illustrate the importance of recognizing the fact that disturbance of function and organic change should be kept equally in mind. To point this out is to dwell on an old and well-recognized fact, but one which is not infrequently overlooked. Some attention to history should enable us to recognize this error.

I am well aware that many will not agree with this view, and hold that the study of and particular attention to disturbance of function are deserving of greater attention than any other phase of the problem of disease. This may be granted with regard to the amount of disturbance which the patient has, but when it comes to the question of the cause of death I think we will find that organic change plays by far the most important part. At the same time we must recognize that in deciding the exact cause of death there must often be great difficulty in judging as to the relative part played by organic change and disturbance of function. To speak truly, both are concerned in many cases. This would seem to render it all the more foolish to give attention almost entirely to one side of the problem.

This comes from the point of view of a clinician and teacher. We are often accused of permitting the laboratory to dominate clinical medicine. That many of our younger graduates fail to appreciate the importance of what they can obtain from the patient by the use of their own senses I must admit. But is the text of my remarks not applicable here? Not infrequently a mistake is made from the lack of realization of organic change as manifested in physical signs. Is the overemphasis on disturbance of function, if I am right in thinking that such exists, not one of the factors which contributes to this? If the teacher neglects a complete study and consideration of organic change, is the pupil likely to do better? The best practitioner, teacher or student is he who recognizes the importance of both and does not allow his vision to be fixed on one to the partial exclusion of the other.

There is always a tendency to look for ways of escaping hard work. Many clinicians lament the tendency to trust to some machine or laboratory test rather than go through the longer process of trying to work out a diagnosis by means of our own senses and

cerebral cells. Is this not a repetition of ancient history? In past times what did the theologians do when the question of orthodoxy came up for decision? Instead of thorough enquiry and painstaking sifting of the evidence, they introduced "tests" of various kinds. The same method came into legal procedure as well, as instanced by the ordeal of battle. To be sure it was a shorter way to an answer, but how correct that answer might be was a matter of doubt.

In this discussion of our attitude to these two aspects of the processes of disease, it is well to remember that our study of the problem should not stop with them. No one can have a comprehensive and clear idea of what disease is doing and intelligently try to remedy its damage without knowing both problems, the changes in structure and the alterations in function. We must endeavor, so far as we can, to understand how the organism or its parts adapts itself to disease. This demands the widest possible consideration and, not least, the study of the patient as a human individual. As it is easy to fix our attention too closely on structural change or alteration of function with resulting blindness to part of the problem, so we may give all our study to these but neglect the study of the patient himself. He has qualities and disturbances which no method of study of function or organic change can demonstrate.

It has been said that, "A new road does not necessarily make the old road useless," and in the study of organic change there are discoveries still to be made. There are many roads to the understanding of disease; what is needed is that all should meet at the end of the journey.

THE INCIDENCE OF ROENTGENOGRAPHICALLY OBSERVED CALCIFIED PULMONARY FOCI AND THEIR SIGNIFICANCE*

A Study of 1034 Patients

By JOHN T. FARRELL, Jr., M.D.

(From the *X*-ray Department, Jefferson Hospital, Philadelphia, Pa.)

Calcified pulmonary foci are due to tubercles which have undergone calcification and occasionally to phleboliths or broncholiths. The tubercle may be that of the initial invasion, the primary *Affekt* of the Germans, or one of a later development, the adult type of clinical tuberculosis. Each has certain characteristics which serve to distinguish it pathologically and to a lesser extent roentgenographically.

The first infection, the primary *Affekt*, is characterized by its onset in childhood; its lack of pronounced symptoms; its situation, occurring as it does, subpleurally and as frequently in the lower as in the upper lobes; and, more striking than any of these, is the response it evokes in the lymph nodes distal to it. All these serve to differentiate it from clinical pulmonary tuberculosis of the adult type.

In 1876 Parrot[1] formulated *la loi des adenopathies similaire* before the Société de Biologie at Paris. Briefly, it was that no infection occurs in the lung of a child without setting up a response in the draining lymphatics. He called the tracheobronchial nodes the mirror of the lungs: and, contrariwise, he argued that no infection of these nodes could occur without there having been a preceding pulmonary infection. Parrot applied the law to other diseases as well as to tuberculosis. Hervouet asserted that in a series of 145 autopsies, performed on children dead of tuberculosis, Parrot always found a lung focus in those in whom there was tuberculous tracheobronchial adenitis.

Koch[2] demonstrated that, when tubercle bacilli are injected sub-

* Read, March 7, 1928.

cutaneously into a guinea-pig free from the disease, a tubercle develops at the site of the inoculation with marked response in the draining lymphatics, and that in susceptible animals there is a generalization of the process leading to death. He also observed that, when a second inoculation is given an animal suffering from the first infection, the life of the animal is prolonged by the chronic course of the disease. He noticed, too, that the second infection produced no change in the lymphatics.

Ghon[3] exhaustively studied the primary complex as seen at autopsy in 184 tuberculous children. In his remarkable text he quotes Küss,[4] to whom he credits the description of the lung focus of the primary complex, as being a single tubercle situated subpleurally and varying in size from a millet-seed to a cherry. Ghon and Küss both say that there may be multiple lung foci, and that the focus may lie well in the center of the lung. Associated with this primary pulmonary tubercle there is tuberculous disease of the draining lymphatics, both of the nodes in the lung and those in the tracheobronchial groups. Ghon, Küss, E. Albrecht,[5] Foedisch,[6] Naegeli[7] and Winkler[8] all emphasize the smallness of the pulmonary focus compared with the extensive lymphatic nodal change. According to Ranke's[9] definition, the primary lung focus and the secondarily infected lymph nodes constitute the primary complex.

That the lung focus is primary and the lymphatic disease a sequence is disclosed by section, when the process in the nodes is found to be younger and of a less advanced stage. To look upon the lymphatic change as primary and the lung focus as secondary would be to argue for retrograde infection, a most unlikely condition since the lymph-flow is away from the lungs and toward the nodes. The triangular distribution of the lesions as disclosed at autopsy, with the apex at the lung focus, likewise argues against such a possibility.

Opie[10] further strengthens the view that the first infection alone is responsible for the lymphatic involvement by his findings in autopsies performed on British soldiers in France. In one of every four of these young adults examined there was tuberculous disease of the mesenteric lymph nodes, varying from fresh caseation to marked calcification. In all of them focal calcification was absent or scant, even though some of the subjects showed apical pulmonary tuberculosis of the adult type. The primary intestinal lesion was only infrequently demonstrated, because as it had developed it had broken into the lumen of the bowel and had been expelled. In this

country bovine tuberculosis is less common than in England, and tuberculous mesenteric adenitis is also relatively rare because here the first inoculation is due to the inhalation of air-borne bacilli and takes place in the lung, rather than in the intestine as is so often the case in England.

In a susceptible child, or with a large dose of virulent tubercle bacilli, the tuberculous process may progress by direct extension and lead to a bronchogenous dissemination of the disease. It may invade a bloodvessel, and end in a hematogenously disseminated tuberculosis: or, again, because of the inability of the tracheobronchial nodes to limit it, it may be lymphogenously spread throughout the body.

Fortunately, since Opie[11] and Puhl[12] have indicated the almost universal existence of the primary complex, the disease does not terminate in this manner. Ghon noticed a gradual decrease in the progressive cases from the first to the fourteenth year, with evidences of healing increasing with the age. According to Opie,[13] in the first two years of life there is almost no tendency to heal; the lesion on the contrary is progressive and tends to spread by caseation. In the great majority of cases the resistance of the individual is sufficient to arrest it; the pulmonary focus and the secondarily diseased tracheobronchial nodes become indurated; calcification takes place and usually, according to Puhl, the process ossifies, producing a laminated bone with canaliculi and often a marrow-cavity.

This course of the first infection in children has been ably shown by all the early investigators, Ghon, Küss, H. Albrecht[14] and Most.[15] E. Albrecht applied it to adults, and Opie and Puhl studied the primary complex, in not only those dead of tuberculosis, but also in children and adults who had died of other causes.

In contrast to the tubercle of the primary complex the tubercle of reinfection offers certain characteristics. It occurs usually after adolescence; if sufficiently large and active or in a susceptible individual it has a train of more or less distinctive symptoms; it is usually apical and central, that is, removed from the pleura; and it evokes no lymphatic response. Subsequent to caseation, with extensive and progressive healing, calcification may take place, and thus are produced the fibrous encapsulated apical tubercles so often seen at autopsy.

Puhl distinguishes macroscopically and microscopically between the primary focus (Figs. 1, 2 and 3) and the focus of reinfection

(Figs. 4 and 5). He found the tubercle of the primary complex to be round, with a fairly even wall setting it off from the sound lung tissue and a quite round zone of necrotic material. Histologically, the central zone of necrosis exhibits a few remnants of nuclear débris. Radially arranged epithelioid cells form an avascular tissue at its periphery. Leukocytes, which, as Aschoff demonstrated, characterize the early stage of softening, are found in this zone. Elastic tissue persists in the center, while at the periphery it is absent and only recurs again in the markedly indurated and atelectatic lung at the extreme outside limits of the area. The thickening of the pulmonary tissue is most marked where the focus reaches the pleura; hyaline stringlike masses appear between the epithelioid cells, kill the cells, leaving a hyaline nuclei-free capsule, Aschoff's specific capsule. Because epithelioid cells do not take up dust well, anthracotic change is usually very slight in the capsule. Sometimes, because of the incomplete protection afforded by the specific capsule against the advance of the infection, typical tubercles with giant cells are found within it. The specific capsule may again be surrounded by Aschoff's unspecific capsule, an area infiltrated with round cells, chiefly lymphocytes. One therefore finds on cross-section two concentric rings, the inner specific capsule of broad nuclei-free hyaline masses and the outer nonspecific capsule of vascular granulation tissue with many nuclei made up of infiltrated lung tissue; the two rings are usually quite distinct.

The focus of reinfection presents a different appearance. Usually irregular in outline, with a correspondingly uneven center of casea-

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Fig. 1.—Grade I. There is a small calcified pulmonary focus in the lower half of the right lung and calcified lymph nodes at the right hilum, indicated by the arrows.

This illustration really shows the more advanced degree of Grade I. Most of the cases which fell into this group had smaller foci, but to minimize the loss due to reproduction this relatively large one has been selected.

Fig. 2.—Grade II. A moderately large pulmonary focus is present in the lower portion of the upper half of the right lung, and calcification at the right hilum is more pronounced than in Fig. 1.

Fig. 3.—Grade III. There is a large calcified focus in the lower half of the right lung with extensive calcification at the hilum.

Fig. 4.—Calcified foci with the characteristics of reinfection; they are apical and multiple. Hilum calcification is not recognizable.

Fig. 5.—Calcified foci with the characteristics of reinfection; they are apical, multiple and bilateral. On the original film it was possible to recognize fibrotic change, indicated by the arrow, in the upper half of the left lung. There is some calcification at the right hilum, but it is impossible to say that any particular pulmonary focus is the primary focus of the initial infection.

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tion running through it as a long strand, this tubercle has for its capsule a broad layer of anthracotic lung so constantly found as to constitute a characteristic of reinfection. Ninety-three per cent of these foci of reinfection Puhl found in the upper lobes, and many of them in the extreme apex. This furnishes a marked contrast to the site of the primary tubercle which was in the upper lobe in only 50 per cent of the cases and rarely at the apex. This reinfection is without an accompanying reaction in the tracheobronchial nodes.

The third source of calcified pulmonary foci is in the occasional occurrence of phleboliths and broncholiths. Opie[11] avers, after the study of a large number of lungs at postmortem, that the incidence of these is so small that they may be ignored and that for statistical purposes all evidences of pulmonary calcification may be looked upon as of tuberculous origin. That the calcification is tuberculous may be demonstrated by the recovery of the tubercle bacillus, in many of the still partially caseous foci by direct smears, and often in the more firmly calcified by animal inoculation.

Opie,[11] who used the *x*-ray in studying the primary complex at postmortem, grades the infection according to its extent into three grades. Grade I includes focal pulmonary lesions up to a millimeter in diameter, with calcified response in the tracheobronchial nodes, no one of which is larger than 5 mm. in diameter, the total extent of the involvement being less than 25 sq. mm. Grade II comprises those cases with a single nodule or several nodules in the lung, varying from several millimeters to a centimeter in diameter, with response in the tracheobronchial nodes that may in some instances be as much as 2 cm. in diameter. Grade III is made up of the cases in which there are conspicuous scattered nodules in the lung substance, with large calcified lesions at the hilum of one or both lungs. In this grade Opie says the lesion may be as much as 3 cm. in diameter.

The present study is based on the roentgen-ray examination of about 1500 living patients referred from the wards and outpatient departments of the Jefferson Hospital between November, 1925, and August, 1926. One thousand and thirty-four examinations have been selected; those in which only single films were made, repeated examinations, and the films of patients under fifteen years of age being omitted. No other attempts at limitation were made.

The examinations have been grouped according to sex, as to the presence or absence of roentgen evidence of adult pulmonary tuber-

culosis, and into age-groups. Fifteen years was chosen as the lower age-limit, and patients from fifteen to twenty years comprise the first group; the successive groups are by decades.

The lower age-limit, fifteen years, was arbitrarily chosen. The choice was influenced by the fact that it is not possible to obtain constantly, much earlier than this, the coöperation necessary for the making of stereoscopic films, and by the difficulty of recognizing first infections and calcifications, a fact emphasized by McPhedran.[16] Calcification has been demonstrated by Puhl experimentally in the lung foci of primary *Affekts* in from sixty-six to one hundred and fifty days; but for practical recognition it undoubtedly requires a considerably longer time. While calcification was seen before fifteen this was the exception and not the rule.

The Criteria of First Infection and Secondary Foci. It is obviously impossible because of the conformation of the chest to recognize all focal deposits, secondary foci or their lymphatic response. When the focus is situated laterally and above the diaphragm, and the nodes fall well away from the mediastinum or are large and densely calcified, no trouble is encountered. But if the lung focus lies below the shadow of the diaphragm, or if the nodes are small and not densely calcified, they may be engulfed in the mediastinal shadows, or be hidden by the aorta or by the overlying spinal shadow, though the frequency with which calcified nodes are seen at the hilum makes one feel that the incidence will not be so low as to invalidate the study.

It is impossible, even with stereoscopic films, to be always certain of the exact anatomical lobar site at which focal lesions are seen; for this reason the chest was divided into four areas, the shadows of the third ribs anteriorly and the seventh ribs posteriorly being chosen as the dividing level for the upper and lower pulmonary fields. Focal lesions have been located in relation to these areas in either lung.

Calcification was recognized on the film by an area of increased density always sharply demarcated in the pulmonary fields from the rest of the lung. At the root-area its presence was determined by the density, location and size of the shadow. McPhedran has shown, by comparison of postmortem findings and roentgenographs of the excised lungs, that foci and nodes which are not considerably enlarged are demonstrable roentgenographically only when they contain calcium salts. Opie's[11] opinion has been quoted as to the

trivial incidence of broncholiths, phleboliths and similar indurated foci and nodelike artifacts.

Sex. (Table I). Of the 1034 patients examined, 623, or 60.25 per cent, were males, and 411, or 39.75 per cent, were females. Of the males 279, or 44.78 per cent, presented evidence of focal deposits in the pulmonary parenchyma; and of the female patients 165, or 40.14 per cent, showed similar changes. There were, in all, 444 patients who exhibited this first infection or the calcified foci of secondary infection, an incidence of 42.82 per cent.

Table I.—Site of Infection

		Number of calcified foci.	Per cent of calcified foci.	Site of calcified foci.
Males 623 60.25%	Without clinical tuberculosis 391 or 61.76%	201	51.40	Right upper 43 or 21.39% Right lower 101 or 50.24% Left upper 30 or 14.92% Left lower 27 or 13.43%
	With clinical tuberculosis 232 or 38.24%	78	33.62	Right upper 16 or 20.51% Right lower 33 or 42.30% Left upper 14 or 17.97% Left lower 15 or 19.23%
Females 411 39.75%	Without clinical tuberculosis 284 or 69.09%	123	43.30	Right upper 31 or 25.20% Right lower 48 or 39.01% Left upper 35 or 28.21% Left lower 9 or 7.31%
	With clinical tuberculosis 127 or 30.91%	42	33.07	Right upper 7 or 16.66% Right lower 19 or 45.23% Left upper 8 or 19.04% Left lower 8 or 19.04%
Total		444	42.82	

Secondary Infection (Table I). The presence or absence of *x*-ray evidence of the adult type of tuberculosis determined the next subdivision. Considering the study as a whole, 675 patients, or 65.28 per cent, were without signs of this secondary infection, whereas 359, or 34.72 per cent, exhibited it. The type and the extent of the disease ran the gamut from a few small isolated tubercles to widespread and far-advanced disease involving all the lobes, and characterized by caseation, cavitation, extensive fibrosis, and

even, in some cases, pneumothorax and hydropneumothorax. No attempt was made to differentiate qualitatively, either roentgenographically or clinically, the variety of the changes. Those with evidence of healing have been grouped with those in whom caseation was undoubtedly the most pronounced characteristic.

Of the 391 male patients without secondary tuberculosis, 201, or 51.40 per cent, exhibited calcified focal changes, while of the 232 patients with the adult type of the disease but 33.62 per cent demonstrated such foci. One hundred and twenty-three, or 43.30 per cent, of the 284 female patients without secondary disease presented evidence of focal changes; while, in this sex-group, of the 127 patients with secondary disease 42, or 33.07 per cent, showed the phenomena.

Site of the Focal Calcification (Table I). In both sexes, and regardless of the absence or presence of apical tuberculosis, the lower portion of the right lung was the site of most frequent involvement. Of the male patients who exhibited the changes, 101, or 50.24 per cent, were located in this area of the lungs; and here too was the site in 33, or 42.30 per cent, of the same sex-group who presented evidence of the apical type of the disease. In the female patients 48, or 39.01 per cent, showed it here when the phenomena of calcification and apical tuberculosis were present simultaneously.

The figures are inconclusive as to the relative frequency of foci in other fields, though the left side in all groups shows consistently a slightly lower incidence.

Age (Table II). There is no evident relationship determinable from this study as to the age incidence of primary *Affekts* and calcified secondary foci. In males without secondary infection it varied, in those groups with a sufficient number of cases to give an accurate estimate of the prevalence, from 37.50 per cent in patients between seventy and eighty years to 58.41 per cent in the twenty- to thirty-year group. The variation in those with secondary infection was from 17.24 per cent in those between forty and fifty years to 57.63 per cent in patients between sixty and seventy years.

Of the female patients without secondary infection the twenty- to thirty-year group evidenced the highest incidence, with 54.87 per cent, and the seventy- to eighty-year group the lowest, with 33 per cent, though the sixty- to seventy-year group presents a better cross-section since it embraces more patients. Those with clinical tuberculosis in this sex-group showed the highest percentage between

the ages of fifteen and twenty years, when it was 42.85 per cent, and the lowest at fifty to sixty with 20 per cent.

TABLE II.—INCIDENCE OF CALCIFIED FOCI

Age group.	Males.						Females.					
	Without clinical tuberculosis.			With clinical tuberculosis.			Without clinical tuberculosis.			With clinical tuberculosis.		
	Number of cases.	Number of calcified foci.	Per cent of calcified foci.	Number of cases.	Number of calcified foci.	Per cent of calcified foci.	Number of cases.	Number of calcified foci.	Per cent of calcified foci.	Number of cases.	Number of calcified foci.	Per cent of calcified foci.
15–19 . .	32	15	46.87	12	4	33.33	40	16	40.00	14	6	42.85
20–29 . .	101	59	58.41	51	17	33.33	82	45	54.87	48	19	39.58
30–39 . .	75	36	48.00	61	23	37.70	86	32	37.20	30	9	30.00
40–49 . .	81	45	55.55	58	10	17.24	38	14	36.84	24	5	20.83
50–59 . .	61	27	44.26	28	12	42.85	21	10	47.61	10	2	20.00
60–69 . .	32	15	46.87	19	11	57.00	11	4	36.36			
70–79 . .	8	3	37.50	3	1	33.33	6	2	33.33	1	1	100.00
80–89 . .	1	1	100.00									

The Extent of Calcified Primary Affekts and Reinfections (Tables III and IV). It is evident, because of the technical difficulties encountered, that one must be uncertain of the exact extent of the involvement. Some of the pulmonary foci must have fallen below the diaphragmatic level, while others must have been hidden by the cardiac shadow; this last would be particularly true of the left lower lobe. The gauge then is not so accurate by this method as by Opie's, nor can the limits of the different grades be accurately defined, though the attempt has been made to impose limits similar to his. Grade I includes those cases of minimal involvement, a small focus in the lung accompanied in most cases by some slight calcification of the tracheobronchial nodes, though in some nodal calcification was not seen (Fig. 1). Grade II includes those in whom the parenchymal and tracheobronchial calcifications were greater, and in this group there was always a recognizable calcification at the hilum (Fig. 2). Grade III embraces only those cases in which there was extensive calcification of the tracheobronchial nodes with a large focus or foci in the lungs (Fig. 3). Many of our cases in Grade I would undoubtedly fall into Opie's Grade II were it possible to measure them. Grade III probably corresponds very well to his

Grade III, though some Grade-II cases would undoubtedly have fallen into this group had they been examined at postmortem.

TABLE III.—EXTENT OF INVOLVEMENT

Age group.	Males.								Females.							
	Without clinical tuberculosis.				With clinical tuberculosis.				Without clinical tuberculosis.				With clinical tuberculosis.			
	Number of cases.	Grade.			Number of cases.	Grade.			Number of cases.	Grade.			Number of cases.	Grade.		
		I.	II.	III.		I.	II.	III.		I.	II.	III.		I.	II.	III.
15–19	32	14	1	0	12	3	1	0	40	13	3	0	14	4	2	0
20–29	101	45	13	0	51	12	5	0	82	29	15	1	48	9	10	0
30–39	75	29	7	0	61	14	7	2	86	25	7	0	30	6	3	0
40–49	81	24	15	6	58	8	2	0	38	10	2	2	24	4	1	0
50–59	61	19	8	0	28	6	6	0	21	2	8	0	10	1	1	0
60–69	32	9	6	0	19	9	2	0	11	3	1	0				
70–79	8	3	0	0	3	1	0	0	6	2	0	0				
80–89	1	0	1	0												

TABLE IV.—INCIDENCE OF GRADE II INVOLVEMENT

Age group.	Males.						Females.					
	Without clinical tuberculosis.			With clinical tuberculosis.			Without clinical tuberculosis.			With clinical tuberculosis.		
	Number of cases.	Number II grade.	Per cent II grade.	Number of cases.	Number II grade.	Per cent II grade.	Number of cases.	Number II grade.	Per cent II grade.	Number of cases.	Number II grade.	Per cent II grade.
15–19	32	1	3.12	12	1	8.50	40	3	7.50	14	2	14.28
20–29	101	13	12.87	51	5	9.82	82	15	18.28	48	10	20.41
30–39	75	7	9.33	61	7	11.47	86	7	8.13	30	3	10.00
40–49	81	15	18.51	58	2	3.43	38	2	5.26	24	1	4.16
50–59	61	8	13.11	28	6	21.48	21	8	38.09	10	1	10.00
60–69	32	6	18.75	19	2	10.52	11	1	9.11			
70–79	8	0	....	3	0	...	6	0				
80–89	1	1	100.00									

Excluding Grade III, because of the few instances of disease of this extent, and considering only Grades I and II, it is interesting to note that there is a gradual though not steady increase with advancing age in the percentage of cases falling into Grade II. That is, the

percentage incidence of focal lesions of moderate extent increases with age. The male patients, who presented no evidence of the adult type of pulmonary tuberculosis, show this particularly well. In them the percentage rises from 3.12 per cent in those between fifteen and twenty years to 18.75 per cent in the sixty- to seventy-year group; in both of these age-groups the same number of cases, 32, were studied. A roughly similar finding is shown in the other sex-secondary disease divisions; but it does not occur so constantly.

Calcification of the Tracheobronchial Nodes (Table V). The extent of calcification was not graded except when it was seen in conjunction with calcified focal deposits. Frequently these pulmonary foci must have developed subpleurally near the root-areas and be included in this compilation as tracheobronchial nodal calcifications rather than as independent foci.

TABLE V.—CALCIFICATION OF THE TRACHEOBRONCHIAL NODES

	Without clinical tuberculosis.		With clinical tuberculosis.		
	Males.	Females.	Males.	Females.	Total.
Total	391	284	232	127	
Bilateral hilum calcifications	152	105	62	39	
Calcifications, right hilum	82	73	52	39	
Calcifications, left hilum	66	43	37	10	
Without hilum calcifications, but with focus	18	8	9	6	
Number and percentage with hilum calcification or with focus	318 81.32	229 80.63	160 67.24	94 74.01	801 77.46
Without hilum calcification and without focus	73	55	72	33	233
Percentage without hilum calcification and without focus	18.67	19.37	31.03	26.19	22.53

Six hundred and sixty, or 63.82 per cent, of all the patients showed calcification of these nodes. Of the males without clinical tuberculosis 300, or 76.72 per cent, showed calcified nodes, while 151, or 65.09 per cent, of those with the disease exhibited them, a total of 451, or 72.39 per cent.

Of the female patients, 309, or 75.18 per cent, presented hilum calcification, of whom 221, or 77.79 per cent, were of the 284 without secondary disease, while 88, or 69.29 per cent, were of the 127 who did show the adult type of tuberculosis.

When calcified parenchymal foci and calcification of the tracheobronchial nodes are considered together, it is seen that all but 73, or 18.67 per cent, of the male patients without tuberculosis of the adult type showed either one or both conditions, an incidence of 81.32 per cent; and of those with secondary disease 67.24 per cent demonstrated similar findings.

Of the female patients those without secondary disease exhibited an incidence of 80.63 per cent of either a calcified lung focus, calcified trachobronchial nodes or both, and an incidence of 73.81 per cent when there was secondary disease.

Comment. Of the 1034 patients, all of whom were over fourteen years of age, considered in this study, 444, or 42.93 per cent, showed calcified focal deposits.

Sex. Male patients show a slightly higher incidence than the female patients, the percentage being 44.78 for the males as against 40.14 for the females. Ickert,[17] who has made a very similar study based on roentgenoscopic examinations of 1336 patients over fourteen years of age, found that they were somewhat more frequent in the females in his series, his proportion being 108 to 100.

Secondary Infection. Of the 675 patients who showed no roentgenographic evidence of the adult type of tuberculosis, 324, or 48 per cent, evidenced calcified foci; while of the 359 with secondary disease 120, or 33.42 per cent, presented these calcifications. In Ickert's series 58.6 per cent of the tuberculous and 55.8 per cent of the nontuberculous exhibited these changes.

Secondary infection, when of any considerable extent, must mask the foci; this is particularly true when there are large masses of caseation or extensive fibrosis in the medial aspect of the lungs. Opie in his postmortem series found a much higher incidence even when there was apical disease present than has been indicated by this study, and the same is true of the studies of Puhl. One would anticipate this difference because of the mechanical difficulties imposed.

Clinically, according to most authorities, it is probably true that the foci represent neither special protection nor unusual hazard so far as secondary disease is concerned.

Location of the Lesion. In all groups, in both the male and female patients, in those with and in those without secondary apical disease, the lower portion of the right lung was the area most frequently involved. This conforms to the roentgenoscopic observations of Ickert, and to the postmortem findings of Puhl and of Opie. Both

Puhl and Opie say that the primary *Affekt* may occur in any place in the lungs, but that it is found most frequently in the best aërated sections. The single area of greatest involvement in the arbitrary fashion in which we have divided the chest is in the right lower portion. Ickert found that the right side was more often affected than the left, as this study has also indicated, and the distribution corresponded roughly to the volume of the area.

McPhedran[16] has called attention to the similarity between the shadows of vessels rayed axially and calcified nodules. The mistaken interpretation of vessels for calcified foci may have been made in this study in some instances, but probably so infrequently that it has had no great influence.

The Incidence of Infection According to Age. There are no absolute conclusions to be drawn as to age incidence. The second age-group, from twenty to thirty years, shows the highest percentage of calcification in three sex-involvement groups; but in the males with secondary tuberculosis the highest incidence, 42.85 per cent, occurred between fifty and sixty years. Ickert also found a relative increase in the number of persons with calcified foci between the second and third decades. Opie found an increase in the extent of the involvement with increasing age.

The Incidence of Grade-II Involvement According to Age. Opie defined his Grade II as being characterized by a single nodule or several nodules within the lung substance varying in size from several millimeters to 1 cm. in diameter, and at the hilum of the lung larger masses which in unusual instances may be as much as 2 cm. across. He says that this grade makes up more than half the lungs seen at autopsy in this country.

Calcification exhibited by the cases in this study could not be so accurately gauged as in lungs examined at autopsy. Our Grade I undoubtedly includes for the purposes of conservatism many cases which, had they been seen at postmortem, would fall into Opie's Grade II. Many shadows suggestive of calcification were discarded when their origin was dubious: cases were only included in Grade II when the focal and tracheobronchial calcifications were pronounced. However, it is interesting to note that in the male patients without adult tuberculosis a fairly constant increase in the percentage incidence of calcification, of sufficient extent to fall into Grade II, accompanies advancing age. This is in accord with the findings of Opie based on the examination of lungs at postmortem.

The increase with age of this grade is not so striking in the other sex-involvement groups.

Calcification of the Tracheobronchial Nodes. Roentgenologically, calcification of these nodes constitutes a better index as to the presence and extent of the primary *Affekt* than does the pulmonary focus. Even at postmortem the pulmonary focus may be found only with difficulty. Compared to the lymphatic changes the pulmonary focus is usually very small. Often it is so situated at the hilium region that it is projected in roentgenographs of the chest in such a way as to be mistaken for calcification of one of the nodes in the area.

McPhedran has pointed out that only the presence of calcium salts in the not markedly enlarged node makes it roentgenographically visible. Studies of postmortem material in numbers of investigations have proved that tuberculosis is the most frequently occurring single factor in the production of calcific deposits. For statistical purposes we may therefore look upon all calcified nodes as of tuberculous origin; and if the series is large enough the unintentional inclusion of calcification due to other causes will not seriously affect the percentage incidence of any one group.

Calcification, either as a pulmonary focus or of the tracheobronchial nodes, was seen in 801 of the patients examined, an incidence of 77.46 per cent. It was appreciably higher in those without the adult type of tuberculosis, being 81.32 per cent in the males and 80.63 per cent in the females; while in those with secondary disease it was 67.24 per cent in the males and 74.01 per cent in the females. Bilateral calcification was the variety most frequently seen, and then followed unilateral calcification at the right root-area, and finally unilateral calcification at the left. The greater number of cases presenting calcification on the right is in accord with the more frequent finding of the pulmonary focus on the right than on the left.

Of all patients examined 801 presented evidence of calcified primary *Affekts*, or calcified foci of reinfection, or calcification of the tracheobronchial nodes. That in the great majority of cases these calcifications are the result of the primary complex is confirmed by the finding of some degree of calcification of the tracheobronchial nodes in 63.82 per cent, a lymphatic response characteristic of the primary *Affekt* and not of the adult type of infection. That this calcification may be looked upon as tuberculous in origin, or as

evidence of an earlier active tuberculous infection, has been amply demonstrated by postmortem studies.

SUMMARY. 1. Of 1034 adult patients whose chests were examined roentgenographically, 801, or 77.46 per cent, presented evidence of a primary *Affekt* or of a calcified reinfection.

2. Of this group, 750, or 72.93 per cent, presented primary *Affekts*.

3. The lower portion of the right lung, the best aërated portion, exhibited the highest incidence of calcified foci.

4. There was a slightly higher incidence of primary lung foci in the male patients.

5. In those without roentgen evidence of apical tuberculosis of the adult type there was a higher incidence of calcification than in those with clinical tuberculosis.

6. No relationship as to age was established in this group of patients, whose ages ranged from fifteen to eighty-four years.

7. With advancing age there was an increase in the proportion of patients showing the more extensive degrees of calcification.

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DISCUSSION

Dr. Willis F. Manges: I think we are to be congratulated upon having one of the younger men of the profession in the city take so deep and scientific an interest in studies of this kind. I believe that studies of this kind are going to shed valuable light on the whole big subject of tuberculosis. It has required a considerable amount of persuasion to get me to the point of believing that all the calcified glands at the root of the lung are the result of tuberculosis. If it is so, I think we have got one definite valuable fact settled. We see these calcified glands so frequently, and at times I think they have importance if for no other reason than for their very size and possible mechanical effects upon the larger bronchi. I think they are capable of producing mechanical irritation under certain conditions. If they are of tuberculous origin, then the question arises should we report these as evidence of tuberculous infection? If they are not, what attention shall we pay to them? I think that the next step in the study should be to make much more clear the significance of the primary bronchial focus. This is associated with a definite process in childhood or early life that should be recognized clinically. I think that fact has not been sufficiently cleared up. I think it is a valuable contribution. It shows these things can be demonstrated graphically. It shows other ways of studying these lesions than at the postmortem table.

Dr. John H. Gibbon: I would ask Dr. Farrell if I understood him correctly when he said that in children these calcified glands are rarely found? It seems queer, if it is true, because we so frequently find in the abdomen of little children calcified mesenteric glands. I may have misunderstood Dr. Farrell.

Dr. Farrell, Jr. (closing): Calcified mesenteric adenitis offers another problem. Dr. Opie, in a study of British soldiers autopsied in France, found in one of every four of these young men, mesenteric adenitis, some showing fresh caseation and others firm calcification. He rarely found calcified pulmonary foci in spite of the fact that very often in these individuals there was clinical tuberculosis—that is, tuberculosis of the apices of the adult type. He concludes that bovine tuberculosis, which is much more common in England, produces the primary disease in the intestinal tract more often than in this country, where the primary infection is only occasionally intestinal. Calcified mesenteric nodes are not so rare as one thinks; while they are uncommon, one does see them on films of the abdomen quite often.

If one finds calcified mesenteric nodes he would be less apt to find calcification of the tracheobronchial nodes, because the former predicates a primary intestinal lesion which is usually stopped in the abdomen and does not spread to the lymphatic nodes in the chest; a later secondary pulmonary infection would not affect the nodes.

I wish to qualify the statement that calcification of the lymph nodes before fifteen is rare, by saying that it is difficult to recognize. I have seen calcification of the tracheobronchial nodes ranging in diameter from 1 to 3 cm. in children from eight to fourteen, but it is an unusual finding; in fact, calcification of this degree is very rare in dispensary and ward patients before fifteen.

In their report on the x-ray appearance of the normal adult chest, Drs. Pancoast, Baetjer and Dunham include the statement of Opie that pulmonary calcification may always be looked upon as of tuberculous origin. I think we may accept this dictum and apply it universally.

POSTOPERATIVE PULMONARY ATELECTASIS AND ITS RELATION TO POSTOPERATIVE PNEUMONIA*

A Demonstration with Motion Pictures of the Clinical Phenomena, Bronchoscopic Drainage and Experimental Production of Postoperative Pulmonary Atelectasis

By WALTER ESTELL LEE, GABRIEL TUCKER, LOUIS CLERF, I. S. RAVDIN and EUGENE PENDERGRASS

(From the Pennsylvania Hospital and the Department of Research Surgery, University of Pennsylvania.)

In February, 1925, we were given the opportunity to place on record before this College a report of the first bronchoscopic examination of a case of postoperative massive pulmonary atelectasis following appendectomy and drainage of an abscess. Dr. Tucker found in this patient a mass of viscid secretion occluding the main right bronchus, and after aspirating the obstructing portion of the secretion the airless lung distal to the obstruction was partially reinflated. Following this reinflation the cough reflex was reëstablished, and within the next seven days the patient had completely cleared the bronchial tree of its accumulation of secretion. In all of the 15 cases in which Dr. Tucker and Dr. Clerf have practised bronchoscopic drainage in postoperative massive pulmonary atelectasis essentially the same conditions were found, and the removal of the obstructing secretion from the bronchi has given relief uniformly.

This work was the direct result of discussions with Dr. Chevalier Jackson by Lee and Leopold of the similarity of the atelectasis in foreign-body obstruction of the bronchi, described by Jackson and Manges, to that found in postoperative massive atelectasis.

Tonight we wish to report to the College the removal of an obstructing mass of bronchial secretion from the left main bronchus of a human suffering with the classical symptoms of massive post-

* Read, March 7, 1928.

operative pulmonary atelectasis, and its injection into the right main bronchus of a dog, and the production in that dog of all the clinical symptoms and physical signs of massive postoperative pulmonary atelectasis. Further, that one of us (Ravdin) has been able to make, in the Department of Research Surgery of the Uni-

Fig. 1.—C. M., male, white, aged fifteen years. Pennsylvania Hospital. Forty-two hours after radical right inguinal herniorrhaphy, massive atelectasis left lung. (Service of Doctor Mitchell. Radiogram by Doctor Bishop.)

versity of Pennsylvania, a mixture of acacia whose physical properties and viscosity are approximately the same as that of the bronchial secretion which we removed from this patient. With this acacia mixture we have been able to produce lesions corresponding to those of postoperative massive atelectasis in 4 different dogs.

We are unaware of any record in literature of the experimental production of postoperative massive atelectasis in animals with the obstructing bronchial secretion removed from a human case. There are, however, definite records of the production of experimental atelectasis in animals by Mendelsohn, in 1841, and again by Lictheim, in 1878, in which foreign bodies were introduced into the

Fig. 2.—C. M., male, white, aged fifteen years. Pennsylvania Hospital. Radiogram taken by Doctor Clerf fourteen hours after bronchoscopic drainage of the obstructing secretion from left main bronchus. (Service of Doctor Mitchell. Radiogram by Doctor Bowen.)

bronchi of animals and obstructing atelectasis was produced. Recently (1928) Corryllos and Birnbaum succeeded in producing atelectasis by introducing rubber bags into the bronchi of animals which they inflated and produced varying degrees of obstruction. But from the literature we must conclude that the experimental production of atelectasis with foreign bodies is difficult, and certainly clinical experience bears this out. That we have succeeded

in thus producing the lesion by transferring the bronchial secretion from a clinical case to the bronchi of animals, and also by employing a synthetic material whose physical properties are similar to that bronchial secretion, is, we feel, due to our ability to destroy the

Fig. 3.—Dog 456. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram taken by Doctor Pendergrass twenty-four hours before the exploratory laparotomy and experimental production of massive postoperative pulmonary atelectasis of right lung—normal. (Lee, Ravdin, Tucker.)

cough reflex in the animals. We are convinced that failures to reproduce this condition experimentally has been largely, if not entirely, due to the inability to destroy the cough reflex. The cough reflex is notoriously efficient in dogs, so efficient that Jackson and his

staff have been hard put to keep the foreign bodies in the bronchi of the animals long enough to permit their students to remove them through the bronchoscope. Corryllos and Birnbaum found it

Fig. 4.—Dog 456. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram by Doctor Pendergrass, three hours after exploratory laparotomy and the bronchoscopic introduction of 7cc. of the obstructing secretion removed by Doctor Clerf from the left main bronchus of the patient C. M. (Fig. 1) with massive postoperative atelectasis. Massive atelectasis right lung, transposition of heart to right of spine. (Lee, Ravdin, Tucker.)

necessary to fix their obstructing rubber balloons to the walls of the bronchi by the use of expanding metal prongs.

We believe from our experimental experience that with a material

of the proper viscosity atelectasis can be produced at will, without any alteration in the diaphragmatic movement other than that

FIG. 5.—Dog 456. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram taken by Doctor Pendergrass twenty-four hours before the exploratory laparotomy and experimental production of massive pulmonary atelectasis of right lung—normal. (Lee, Ravdin, Tucker.)

produced by the variation of the negative pressure in the pleural cavity which follows the atelectasis, provided the cough reflex is abolished.

In the 36 cases of postoperative massive atelectasis whose records we have been privileged to study, and in the 12 cases in which the obstructing bronchial secretion were drained bronchoscopically, we are convinced that three factors have been constant: (1) Some

Fig. 6.—Dog 456. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram taken by Doctor Pendergrass three hours after exploratory laparotomy and the bronchoscopic introduction of 7 cc. of the obstructing secretion removed by Doctor Clerf from the left main bronchus of the patient C. M. (Fig. 1) with massive postoperative atelectasis. Massive atelectasis of right lung, elevation of diaphragm. (Lee, Ravdin, Tucker.)

inhibition or restriction of the respiratory movement; (2) an inhibition or loss of the cough reflex; (3) an accumulation in the bronchi of a thick, viscid bronchial secretion. Because of the thick, tenacious character of this bronchial secretion, and the inability or dis-

inclination of the patient to clear it from the bronchi, it accumulates in the dependent portions of the bronchial tree until at some point,

Fig. 7.—Dog 555. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram taken by Doctor Pendergrass twenty-four hours before laparotomy and the experimental production of massive postoperative atelectasis of the right lung—normal. (Lee, Ravdin, Tucker.)

or points, in this stream of mucus the lumen is completely occluded. If this occlusion takes place in the small bronchioles, we will have lobular atelectasis (bronchopneumonia); if it accumulates and

obstructs the bronchus leading to one lobe, we have lobar atelectasis (lobar pneumonia); and if it occurs in the main bronchus of either lung, we will have massive atelectasis (massive pneumonia, pleural effusion or empyema).

FIG. 8.—Dog 555. Laboratory of Surgical Research, University of Pennsylvania, Philadelphia. Radiogram taken by Doctor Pendergrass three hours after exploratory laparotomy and the bronchoscopic introduction of acacia into the main bronchus of right lung. Massive atelectasis of right lung and transposition of heart to right of spine. (Lee, Ravdin, Tucker.)

We have demonstrated both clinically and experimentally that if this obstruction can be overcome by making the patient cough, by changing his position, as suggested by Santee; by vigorous shaking, and in the young children by actual spanking; by deepening the

respiratory movement; by inhalations of carbon dioxide, as suggested by Scott, and thus an airway be established past this point, or points, of obstruction, the patient may, temporarily at least, free the bronchial tree of large masses of secretion and reinflate the pulmonary tissues. In 15 cases Dr. Chevalier Jackson and his associates have found it necessary to deliberately aspirate through a bronchoscope the obstructing portion of this bronchial secretion, and in each case increased aëration and partial reinflation of the pulmonary tissues distal to the point of obstruction has followed.

Though massive or total atelectasis is the lesion that has attracted most attention, and the one usually recognized, we suggested in 1923 that varying degrees of atelectasis occurred postoperatively, and further that the lobular and lobar types were possibly more common than the dramatic and easily recognized massive form. We further suggested that in these areas of atelectasis embolism and subsequent infarction occurred postoperatively, and that these factors were more or less constant in all postoperative pulmonary complications. Mastics, in a recent report, estimates that 70 per cent of the so-called postoperative and postanesthetic pneumonias are varying degrees of atelectasis. As a result of our continued interest in the subject and the opportunity to carry on experimental work, we feel that we now present both clinical and experimental evidence to support the belief that in the small proportion of true pneumonias which develop postoperatively, all start as varying degrees of atelectasis, and upon these lesions are superimposed embolism, infarction and infection.

Conclusions. 1. We suggest that atelectasis in varying degrees, lobular, lobar or massive, are constant factors in postoperative pulmonary complications.

2. That subsequent to and associated with atelectasis we may have embolism, infarction and infection, with true pneumonia, lung abscess or empyema as terminal processes.

3. That if the embarrassment of the respiratory movements, inhibition or abolition of the cough reflex and accumulations of masses of viscid bronchial secretion in the dependent portions of the bronchial tree are causes of postoperative atelectasis, we have definite and clear-cut indications for its prevention and treatment. Is it too much to claim that this gives us a new conception of the pathology of postoperative pneumonia, and suggests methods for the prevention of the development of pneumonia in the simple lesion of atelectasis.

DISCUSSION

Dr. Chevalier Jackson: I do not know how to discuss this. I am simply overwhelmed by this masterful presentation. Apart from the subject matter, the way in which it was presented was simply masterful. I do not know that I am well selected to open the discussion, because I am interested. Nevertheless, I will say what occurs to me. In the first place, why does Dr. Lee get so many cases of postoperative massive collapse, or atelectasis; why does he get so many more than any other surgeon? The best explanation is well illustrated by something which occurred forty-three years ago when I went from Philadelphia to my home in Pittsburgh and encountered my old friend, Dr. Wood. He said, "Look here, Chev., there is a surgeon here in town who operates on every case of cholera morbus, calling it appendicitis. I have been practising medicine forty years and I never saw a case." I replied, "You mean you never saw a case, or you never recognized a case?" Gentlemen, I think the surgeons today are seeing a good many cases, but they do not recognize them. I think Dr. Lee recognizes them, and that is the reason he gets so many. Another instance that illustrates the same thing: all the laryngologists used to say, "How in the world does Jackson get so many foreign-body cases out in Pittsburgh?" The way he got so many was by getting in close touch with the interns on admission. I found, when the mother brought a child in with the history of choking on something, the intern took the child's temperature, which was usually normal; the child did not seem to be choking and was sent home. I got in touch with every intern, and told him that every child brought in with the slightest history or symptoms of choking at all was to be regarded as a case of foreign body until I saw it; when I saw it the roentgen-ray man saw it, and usually also the internist. It was not a matter of seeing so many cases, but of recognizing so many cases. These studies of Dr. Lee, bearing on etiology, are important, especially for prophylaxis. The most important point is not that these patients are cured by bronchoscopic aspiration, but rather the light shed on etiology. If we find out what causes these cases we can prevent them. Prevention is better than cure, even cure by bronchoscopic drainage. There are two theories, speaking broadly, as to etiology: one is the mechanical theory; the other you might call—using the term in a very loose way—the neurogenic theory. As for the neurogenic theory, I recall that when I was a little child a missionary came home from India and told of the Indian magician who threw a rope up in the air, and how the rope stood there while the magician climbed the rope, and then disappeared. I did not believe it then and I do not believe it now; from that day I have been a hopeless materialist, and often I think of that rope when I read neurogenic explanations of various phenomena, especially when, as in so many cases, there is an overlooking of the obvious. For illustration, a good many years ago I read through seventeen pages of the *Berliner Klinische Wochenschrift* on the neurogenesis of cardiospasm. I was hopelessly bewildered; my German was imperfect and I spent a good deal of hard-earned money getting a translation of those seventeen pages, and

even after getting a good translation I was lost in a wilderness of theory, so I went to an old German friend of mine, who, after he had spent a large part of the night reading the paper, said, "Well, Chev., these German physiologists and neurologists go so far into the realm of theory that none of the rest of us can follow." Then I thought of that rope, and so it has been with many another thing. Similarly elaborate explanations have been given for thymic death, thymic asthma; nevertheless, when we looked down with the bronchoscope, we found the windpipe was compressed by the thymus. There was no call to go into any wilderness of theory. It was a simple mechanical fact that the trachea was closed. There are tomes written on the neurogenesis of asthma, and still we find patients coming in with a diagnosis of asthma in whom we find the symptoms are due to collar buttons. One child treated for eight months for asthma had a collar button in the trachea. Many of the asthma patients have some sort of stenosis of the trachea. So-called cardiospasm, when we come to examine it objectively, we find to be, in about 90 per cent of the cases, cancer; in 5 per cent it is due to some other fundamental lesion; in no case is it at the cardia or spasmodic. The bearing of all this is that I am incapable of understanding the latest neurogenic theories on what is to me a purely mechanical problem. While I know I am a mere plumber and unable to see anything but pipes, instrumental and natural, nevertheless, it seems to me a fundamental fact that in atelectasis we have a lung into which the air is not getting. Before anyone starts to explain that by neurogenic theories, it seems to me necessary to know whether the pipes are open to let the air down.

Dr. Hobart A. Hare: Dr. Jackson will pardon me if I suggest that the whole problem is not concerned with the air going down, but of air being absorbed below the obstruction. The authors of the contribution we have just heard have carried out so important a research surrounded by so many safeguards against error that it needs no praise and deserves no criticism. It seems well proven that the removal of a plug of viscid mucus, if done early enough, results in reinflation of the lung, but it is not equally clear that the presence of the plug as a mechanical obstruction alone causes atelectasis. If viscid sputum causes atelectasis, why does this lesion so rarely complicate croupous pneumonia with its very viscid sputum or tuberculosis with its cheesy masses? In other words, is there something in certain types of sputum which has an action of its own, just as Jackson has shown that a peanut is a very toxic agent in a bronchus, whereas a metal object is not? This would seem the more likely, because the atelectasis does not seem to immediately follow the plugging, at least in human beings, perhaps because time is needed for the gradual absorption of the residual air in the affected lobe or lobes.

It would be interesting to discover whether the plug which causes trouble has some chemical or bacteriological factor in it, as does the peanut, if it is to be potent. Does sterile sputum cause collapse, and would sputum infected artificially with different organisms be worthy of study? In other words, is the collapse purely mechanical or is it partly toxic? Does a blood-clot act as does sputum?

Does sputum from the mouth, by virtue of its bacterial content, cause atelectasis, whereas sputum coming from below not do so? That sputum from the mouth may be very infectious is shown by the frequency of pulmonary abscess after tonsillectomy.

Another point of interest is the occurrence of atelectasis after thoracic injury, in which instance a plug may or may not be present. That is, does the chest injury, directly or indirectly, impair bronchial movement? This question is of greater interest than would appear at first sight, because Macklin has shown that the normal tubes extend and shorten greatly on inspiration and expiration, and the shortening on expiration must do much toward raising sputum toward the mouth. It would be interesting if by pathological study it could be determined that this elasticity varies at different ages, as does that of the bloodvessels, and again what changes are induced in the bronchial muscularis which must vary in its contractile power at different ages and in different diseases. It has been definitely determined that the bronchial mascularis receives motor and inhibitory fibers from the vagus, that is bronchoconstrictor and bronchodilator fibers, and pilocarpine and muscarine cause constriction which atropine overcomes. So, too, foreign proteins, as in anaphylaxis, may cause this constricting effect. Perhaps anaphylaxis might be benefited by bronchoscopy, although in this state vesicular distention occurs instead of collapse.

A point which may be deserving of investigation lies in the efficiency of the diaphragm, for if this great muscle is disabled by impaired innervation or mechanically there cannot be the excess of air inhaled which is needful to provide a good cough. In the days when enormous ovarian cysts were permitted to develop without operation I have seen the lower thoracic segment and the diaphragm entirely impotent after the cyst was removed, because the diaphragm was so relaxed that it was drawn up toward the clavicles on attempted inspiration. A similar diaphragmatic impairment to a less degree, nervous or mechanical in origin, may prevent cough which the authors have shown to be useful. Experiments with phrenic section might be useful. I have cut the phrenics in animals from the monkey to the rabbit, including the horse, without death ensuing, contrary to old surgical teaching. Posture in obese persons on the Trendelenburg table, up or down, may cause serious respiratory embarrassment, and if a rabbit is held by the ears so that its belly contents fall away from its diaphragm it is soon in great distress. These facts support the author's views that strapping the upper belly is provocative of atelectasis.

Once more, the fact that the bronchial cilia are constantly moving secretion upward in health is not to be forgotten, and studies of the ciliated epithelium of the tubes by placing particles of carbon on the mucous membrane might be made, as they have been made, in the case of the Fallopian tubes, and the membrane lining the sinuses and the nose by Schaeffer. The toxic action of certain types of sputum may arrest this movement. Whatever may be our ultimate knowledge of this subject, it clearly shows that interference with lower thoracic and diaphragmatic movement is to be avoided, and that to let a patient lie on the back when coming out of ether instead of occasionally turning him from side to side is probably unwise, as the lateral postures would aid drainage.

It is easy to make suggestions and difficult to carry them out, but it is not difficult to see that the common method of using morphine before and after operation to stop cough, or to act as an antibechic as Jackson calls it, while it aids anesthesia, may be the cause of ultimate disaster. The common use of atropine seems wise.

Lastly, it is of everlasting importance that we bear in mind that thoracic symptoms after injury and operation should not lead us into a diagnosis of pneumonia, but make us think of atelectasis, of the *x*-rays, and the life-saving powers of the skilful bronchoscopist.

Dr. John H. Jopson: It seems to me that the paper of Dr. Lee and his associates has probably solved the question as to the method of causation of this lesion of massive collapse in the great majority of cases. Some of this material was presented only a few days ago at a joint meeting of the New York and Philadelphia Academies of Surgery. At that time Dr. Lilienthal, of New York, was present and discussed the subject. Instead of demonstrating or claiming as he does in his book on pulmonary surgery that what Dr. Jackson calls the neurogenetic theory was primarily responsible for this lesion, he contented himself with stating that at least a certain number of cases were explainable in that way, and were perhaps due to muscular contraction in the bronchioles, and even in the pulmonary alveoli, and not to mechanical obstruction to the bronchial tree with, as Dr. Hare emphasized, subsequent absorption of the air in the obstructed lung. Now whether there is anything that precedes this accumulation of mucus or not, and what effect, for example, preëxisting infection in the bronchioles exerts, Dr. Lee has not stated. It seems to me that by the collection of a sufficiently large series of cases we will be in a position to say whether preexisting infection plays an important part. We will be able, also, to classify more accurately the causes in regard to types of operation, types of anesthesia, methods of after-treatment, etc. The experimental production of this lesion, it seems to me, is of paramount importance, and the fact that these gentlemen were able to produce atelectasis in the dog by sterile solution of acacia without other factors than an operation coming into play is, I think, the strongest argument for their explanation of the mechanics of it. I think this opens up a field for investigation in other problems than atelectasis alone. The ability to produce in the normal animal a collapse of lung with the increased negative pressure which goes with collapse, seems to me to open an interesting field for experimentation in regard to the claims of Graham, for example, with respect to intrathoracic pressure. Dr. Jackson has touched on this subject from the clinical point of view and has very reasonably explained why Dr. Lee has been able to report so many more cases than other surgeons. I recall when Dr. Pfeiffer came back from a meeting, some years ago, where this subject was discussed, and at once picked up a case of pulmonary collapse in the Presbyterian Hospital. It is a lesion which is easily detected in massive cases, both clinically and by the *x*-ray. I must confess that, though I have been on the lookout for cases for some years, I have not had the good or bad fortune to see many cases. With regard to the percentage of pulmonary complications, I had one of

my assistants look over a number of cases this week to determine the percentage of major operations. He was able to find that between 5 and 6 per cent showed sufficient pulmonary symptoms for a record to be made on the history chart. Massive collapse of one lobe of the lung occurred once in 88 cases and recovered. One case of hernia developed frank pneumonia and empyema, from which he succumbed. The remaining cases showing respiratory complications were mostly but slightly affected. So that I have not been able to recognize any great number of cases perhaps because, as Dr. Jackson pointed out, I have not searched hard enough for it. In really well-developed cases, if one has it in mind, it is not easy to overlook. I think another clinical lesson this teaches is that we must always bear in mind the necessity of postponing operations of election in cases where there is any acute infection of the respiratory passages, and where operations of urgency are demanded, the choice of the anesthetic, the extentof operative procedure, and the after treatment be conducted in such a manner as to minimize the chance of aggravation of the respiratory complications.

Dr. Elmer H. Funk: It has been my good fortune to see some of the patients under Dr. Lee's care in the Pennsylvania Hospital, and the striking thing clinically was the marked physical signs which are presented by these patients. One wonders why the cases were overlooked in the past when such obvious signs may be found on examination. It may be that frequent and careful postoperative chest examinations were not made. The cardinal signs are displacement of apex-beat toward the affected side and displacement of the trachea toward the affected side. Fortunately, the condition is usually unilateral, but our distinguished president will recall one patient with a postoperative pulmonary complication, in whom we thought of postoperative collapse, but in whom no obvious displacement of the heart or trachea was present. The patient died, and at autopsy a bilateral partial collapse of both lower lobes was found. Recently, I had the opportunity of studying the altered diaphragm movements in patients operated upon by Dr. John B. Flick, and in whom a phrenic exeresis was done. These findings give no support to the view that phrenic paralysis is an important cause of postoperative pulmonary collapse. The most reasonable explanation is that there is bronchial obstruction by thick viscid secretions with absorption of retained air in the corresponding lung field. After bronchoscopy one not infrequently finds that breath sounds previously suppressed may be easily heard. These may disappear again with the recurrence of collapse. The rapidity with which collapse may occur has been a striking revelation to me. One patient operated upon in the afternoon developed toward evening definite signs of collapse, with marked displacement of the apex-beat. The next morning all signs of collapse had disappeared. The fact that collapses may be transitory may explain why in some instances, at least, it is not discovered. There is no question in my mind that Dr. Lee is correct in his opinion that postoperative pulmonary collapse is not a rare condition, and that it should be suspected whenever a postoperative pulmonary condition occurs.

Dr. Simon S. Leopold: My first experience with massive collapse of the lung dates back to 4 cases observed at Camp Dix early in 1919. They were all seen during a period of sixteen days, suggesting the thought that many similar cases must have been diagnosed something else, probably postoperative pneumonia. It was not until I had opportunity to study the literature after my discharge from the service, particularly the pioneer writings of William Pasteur in England, that the diagnosis of this group of cases was truly appreciated. These 4 cases, each with daily *x*-ray studies during their collapse attack, were presented before the Morgan Society in April, 1923, and subsequently published in the *American Journal of the Medical Sciences* in March, 1924. Case II of this series was unique in that alternate collapse and reëxpansion occurred three times in six days, corroborated by symptoms, physical signs and *x*-ray. In the light of Dr. Lee's recent contribution, it is probable that the bronchial obstruction was temporarily dislodged by coughing, but recurred

The extreme radiographic density of the atelectatic area suggested retention of fluid in the collapsed lung, and the analogy was drawn between this condition and Dr. Jackson's description of the picture produced by complete bronchial obstruction due to foreign body. Consequently the paper was entitled "Massive Pulmonary Collapse and Drowned Lung." The opinion was advanced that complete bronchial obstruction offers the best explanation for the cause of this condition, despite the fact that direct bronchoscopy during a collapse attack had not been done. A very short time after this it was the good fortune of Dr. Lee to encounter a case, and Dr. Tucker was able for the first time to demostrate the obstruction, remove it by aspiration and produce reëxpansion of the affected lobe.

In regard to the incidence of this condition, I am entirely in accord with Dr. Lee that most postoperative pulmonary complications are due to it, and in the article on this subject in Blumer's *Bedside Diagnosis* it is stated that the frequency with which massive collapse of the lung is diagnosed depends in the first place on the knowledge of its existence, and in the second place on its differentiation from that all-inclusive misnomer, postoperative pneumonia. The growing literature on this subject in the past three years would seem to justify the correctness of this view.

Dr. Lee and Dr. Tucker are to be congratulated for being the first to demonstrate the cause of postoperative pulmonary collapse by direct bronchoscopic examination. Dr. Lee, Dr. Tucker and their coworkers have done a splendid and ingenious piece of research in reproducing this condition experimentally, in dogs, both by the use of the material aspirated from the bronchus of a clinical case and by the use of an artificial substance of identical viscosity.

It would be interesting to know how many of Dr. Lee's patients received morphine prior to operation. If Dr. Lee has that information I would be grateful for it. Regarding the mechanism whereby pulmonary atelectasis is produced, I believe that we are all convinced that the postoperative cases are due to bronchial obstruction. Sir John R. Bradford asserts that from 5 to 10 per cent of the patients with gunshot wounds of the thorax and other wounds, such as crushing injuries of the pelvis and thigh, are

followed by massive collapse of the lung even in those cases where there has been no penetration of the pleura. Whether we accept a neurogenetic theory to explain these phenomena or not, it seems apparent that those cases have a different explanation than those occurring postoperatively.

Dr. John R. Paul: The pathologist may perhaps be censured for not having placed more emphasis upon the condition of pulmonary atelectasis, perhaps because one sees pulmonary atelectasis at the autopsy table so frequently that it is difficult to conceive of its being responsible for a clinical entity such as the one Dr. Lee has described. I have been interested in Dr. Jopson's reference to the question of previous respiratory infections as a predisposing factor in these cases, and this point has been brought home to me in the two autopsies which I have had the opportunity of studying on cases of postoperative pulmonary atelectasis, in both of which the patients had bronchitis. One might almost predict that there may be a close relationship between the number of cases of postoperative pulmonary atelectasis and the number of patients with acute bronchitis on whom abdominal operations are performed. In spite of the fact that many cases thought to be examples of postoperative pneumonia are in reality instances of pulmonary atelectasis, I do not believe that we are ready as yet to cast the term "postoperative pneumonia" into the discard, for we do not know the degree to which atelectatic lung tissue may predispose to infection and become the seat of a pneumonia.

Dr. John H. Gibbon: I think Dr. Lee has proved his case. He has convinced me that this postoperative complication is much more common than we think. I have had only a very few cases, but I think it is because we have not looked for them. One reason why I think they are not recognized is because a great many of them are quite transient, as suggested by two of the speakers, and yet this is unlike a pneumonia. The patient has a rise of temperature, rise of pulse-rate and then it as suddenly subsides. Others again will behave in this way and after a few days there is a recurrence. I think a great many of them get well and that is one reason why they have not been detected. Our roentgenologist at the Pennsylvania Hospital thinks morphia has something to do with this condition. If these postoperative lung complications are due to collapse and are not due to pneumonia, then I would like to say that they were a great deal more frequent before the common use of morphia as a part of the anesthesia was established. I think, moreover, if morphia plays a great part in this we should see the condition just as often as after other types of operation, which is not the case.

Dr. Lee (closing): So many points have been developed in the discussion that time will not permit of a reply to each one of them. That our incidence of postoperative pulmonary atelectasis seems to be higher than is usually reported is explained by the alertness of our house surgeons. As far as I can recall, every one of the cases reported were first recognized by the house surgeons in the various hospitals and subsequently confirmed

by us. The fact that the incidence in our postoperative cases is increasing as our experience develops encourages us in the hope that we may be able in time to recognize a proportion as high as that reported by Mastics—50 in a group of 450 consecutive major operations. Preoperative respiratory infection, we feel, is a very important etiological factor. From our impression we would say that practically all of this group of cases, certainly all which we have bronchoscoped, have had preöperative bronchial infection. The operative notes of the patients bronchoscoped, contain a note made by the resident surgeon that the patients have had difficulty during the anesthesia and excessive amounts of mucus in the nasal pharynx during the operation and postoperatively. As to the effect of morphia, we have used it preöperatively in all the cases bronchoscoped. As a matter of fact, it is a routine procedure in all of our surgical services. Perhaps the most important contribution to this work consists in the demonstration of the necessity for the preservation of the cough reflex. Dr. Ravdin and Dr. Tucker will bear me out in the reiteration of our statement that unless the cough reflex is destroyed it has been impossible for us to experimentally produce pulmonary atelectasis. The routine or the indiscriminate use of morphia, pre- and postoperatively, with the object of allaying and inhibiting coughing, would seem to be a contributory factor in postoperative pulmonary atelectasis.

HARVEY'S PREDECESSORS AND CONTEMPORARIES*

The Mary Scott Newbold Lecture
Lecture XIX

By SIR HUMPHRY ROLLESTON, Bart., K.C.B., M.D.
CAMBRIDGE, ENG.

Even at the present time when discoveries and advances are so constantly presented to the medical profession, there is an attitude of wise caution not unaccompanied by some reluctance and even, at least from reactionaries, opposition to a new idea. What then must have been the feeling and antagonism aroused when William Harvey's *Exercitatio anatomica de Motu Cordis et Sanguinis in Animalibus* (1628), with its entirely new conception of the circulation of the blood, challenged the sacrosanct teaching of Galen which had dominated medicine for more than fourteen centuries? He must have appeared as Zachary Wood,[1] "Physician of Rotterdam," expressed the position in 1673:

> "Truly a bold man indeed,
> O Disturber of the quiet of physicians!
> O seditious citizen of the Physical Commonwealth!"

His opponents went so far as to call him a quack or "the Circulator," using this Latin word in Martial's sense of a charlatan, and according to the gossipy John Aubrey his practice fell mightily after the appearance of the *De Motu,* as he was regarded as "crackbrained by the vulgar and all the physicians were against him." Harvey fully recognized the significance of his action, for, though on April 17, 1616, a week before William Shakespeare's death (April 23, 1616), he first set out his discoveries, he did not make any public announcement but continued for years to strengthen his argument with fresh data in his Lumleian lectures at the Royal College of Physicians of London. According to Willis,[2] there is every reason to believe that the *De Motu Cordis* was written before 1619, but it was not until 1628, an interval of twelve years from his first public demonstration, and when he was fifty years of age, that he thought the time had come to publish at Frankfort, then a central mart for books, his

* Read, March 22, 1928.

modest but immortal small quarto of seventy-two pages containing the doctrine which he afterward remarked no man over the age of forty accepted. The dedication of the *De Motu Cordis* "to his very dear Friend, Doctor Argent, the excellent and accomplished President of the Royal College of Physicians, and to other learned Physicians, his most esteemed Colleagues," expresses Harvey's anxiety not to broadcast his discovery before it had been submitted to them and received their support. It is noteworthy that in this rare patience and restraint Harvey not only acted on the example of Copernicus, who waited thirty years before publishing *The Treatise of Revolutions*, but was followed by his surgical peer, John Hunter, who was born late at night February 13–14, 1728, or nearly a hundred years after the *De Motu Cordis* saw the light, so that these two centenaries coincide. Hunter, with similar caution, was reluctant to publish his observations and worked for eighteen years before, at the age of forty-three, he brought out, in 1771, his first work, *A Treatise on the Natural History of the Teeth.* This self-denial in proclaiming a discovery is a striking characteristic of the truly great, and Sir William Osler[3] gives a number of other instances in which a long delay was self-imposed, such as the twenty years before Newton published his discovery in the *Principia*, the twenty years that John Napier, Laird of Merchiston, pondered over logarithms before confiding this knowledge to the world, the seventeen years which elapsed between the first draft and the publication of Charles Darwin's *Origin of Species*, and the twelve years that Francis Bacon kept the *Novum Organon* by him before he published it in 1620, and after making, it is said, twelve drafts. Admirable as is the the desire for perfection, it may, as in Harvey's case, deprive the world of other advances, such as may have been contained in some of his works of which the titles only have come down to us, for example, his promised *Practice of Medicine Conformable to his Thesis of the Circulation of the Blood, Observations on the Function of the Spleen*, and *De Insectis.* In his "First Anatomical Disquisition on the Circulation of the Blood," addressed to John Riolan, he refers to his intended *Medical Anatomy in its Applications to Medicine*, and in the Second Disquisition to the same critic twice mentions his projected *Medical Observations.* The loss of such a record from such an observer is a matter for special regret. Some of these may have been destroyed when his house in Whitehall was plundered by the Parliamentarian troopers during the civil wars at some date not

later than 1646; others, it is conjectured, may have been burnt in the fire of London in 1666 when, after his death in 1657, his papers were stored in the College of Physicians, then in Amen Corner. Sir George Paget,[4] perhaps rather optimistically, argued that, as there is not any proof of the destruction of Harvey's unpublished papers in the Great Fire, it may be hoped that they are still extant somewhere.

When a new discovery is made known its adverse reception may take the forms of questioning its claim to priority and ascribing the credit to others, or of denying its truth. It may therefore be worth while, in the tercentenary of the publication of William Harvey's epoch-making discovery, to glance briefly at his predecessors and contemporaries in connection with the circulation of the blood.

There is a temptation to read into the substance and speculations of former writers a prophetic anticipation or even priority of later and well-established additions to knowledge; though attractive, this pursuit is often fallacious. Some enthusiastically ingenious interpreters of Shakespeare's references to the blood have seen in his various plays an approach to an anticipation of Harvey's discovery, or even, like Thomas Nimmo, have suggested that Shakespeare had direct information on the subject from Harvey, who, as already mentioned, gave his first lecture on the subject a week before Shakespeare's death. There is not any means of coming to a decision on this last suggestion; but judging the quotations on their merits we must agree with St. Clair Thomson,[5] who has collected a number of them, that they merely voiced the long-accepted view that the blood moved in the vessels and that Shakespeare did not have any conception of the complete circulation. As an extreme example of what piously biassed imagination may bring forth, John Smith's remarkable opinion, in his *Pourtraiture of Old Age* (1666), a paraphrase of "the six former verses" in the twelfth chapter of Ecclesiastes "made plain and easie to a mean capacity," may be mentioned; he asserted (p. 233) that King Solomon accurately knew the details of the circulation of the blood, "yet it pleased the Lord that this knowledge should with the possessor of it sink into dust and darkness, where it lay buried for the space of 2500 years at the least, till it was retrieved therefrom by the wisdom and industry of that incomparable and forever to be renowned Dr. William Harvey, the greatest honour of our Nation."

It is, however, also true that before a new advance is made the

idea is often in the minds of a number of active workers, and it may be almost a matter of chance who solves the problem first; this last statement applies with fair truth to the discovery of *x*-rays by Röntgen in 1895, but not to that of Harvey, though of course others about that time wrote, often with little basis of observation or experiment, on the vascular system.

HARVEY'S PREDECESSORS. Although quoted by Harvey more often than any other writer, the views of Aristotle (384–321 B.C.) deserve more attention than perhaps they usually receive in connection with the discovery of the circulation of the blood. He knew that the arteries carried blood, vaguely foreshadowed the existence of capillaries, and by locating in the heart the production of the vital or innate heat which, by making the blood boil with the "pneuma" or vital spirit, was regarded as responsible for cardiac expansion and its subsidence (for neither he nor Galen realized its muscular contraction, which Leonardo da Vinci first recognized), Aristotle made the heart the important organ not only in the body but with regard to the bloodvessels.

Erasistratus (330–245 B.C.) has been described as the first scientific physiologist, and like his contemporary, Herophilus, was accused, probably falsely, of vivisecting criminals. His addition to the knowledge of the circulatory system was the description of the auriculoventricular valves and their mode of action, but he gave to the liver the place in the blood stream which Aristotle had ascribed to the heart and believed that the arteries contained air. Like Aristotle, he also imagined that there were synanastomoses or communications between the arteries and the veins; but this was only to explain why an incised artery gave out blood. As Crawfurd[6] expresses it, Erasistratus the surgeon, who knew that blood issued from a severed artery, found himself in conflict with Erasistratus the physiologist, who held that the arteries, as their name implies, contained air, and was therefore driven to the elaborrate and certainly ingenious hypothesis, which his contemporary Praxagoras of Cos also professed, that when an artery was opened the pneuma or air escaped, and to prevent the vacuum abhored by nature the normally closed communications between the arteries and veins opened and allowed blood to fill the wounded artery.

NOTE.—In connection with the hypothesis of direct communications between the arteries and veins it is interesting to note that J. T. Wearne[7] has shown that in the myocardium there are direct

communications between branches of the coronary arteries and the Thebesian vessels, so that blood from these arteries may pass without traversing the capillaries into the cardiac cavities, and further suggests that when the orifices of both coronary arteries are slowly obliterated the Thebesian vessels may convey the blood from the cardiac cavities to the myocardium.

Galen (131–200 A.D.), who has been called one of the greatest anatomists and physiologists of the world (Payne[8]), and "the Father of Vivisection" (van Leersum[9]) was also a clinician and encyclopedist; but in spite of this he passed into oblivion in the dark ages. With the renaissance and the revival of Greek he again became dominant, and, in spite of Paracelsus' dramatic rebellion against Galen in particular and anatomy in general and Vesalius' more valuable critical revision of some of his anatomical statements, remained so for a long time. It has been thought that Galen's literary style stands in the way of his due appreciation by the modern world, and there certainly has been, perhaps as a reaction against his former supremacy, a decided tendency to insist more on his mistakes, which in some degree occurred because his observations on man were few and hurried, than on his services to medicine. These services were great. In addition to being an original dissector, experimenter, and an encyclopedic writer, his insistence on the importance of anatomy led, after the renaissance, to the revival of anatomy, without which the discovery of the circulation might have been much delayed; had it not been for this result of his influence, medicine would probably have remained long in a state of pure empiricism and not been placed on a scientific basis. Galen, therefore, was an important forerunner of Harvey, and indeed without Galen who, Payne considered, has perhaps been more persistently misunderstood and even misrepresented than any other man of equal intellectual rank, there might not have been the discovery of the circulation in Harvey's time. Like Aristotle, he recognized that the arteries contained blood and that the blood from the left ventricle was driven over the body; but by stating that the blood from the right ventricle must pass to the left through innumerable invisible foramina in the interventricular septum, he has been much blamed for hindering correct physiological knowledge; but, as Payne shows, Galen's methods were sound, as they consisted in observation on animals, though some of his deductions were entirely erroneous.

In discussing the interesting question why Galen, who in many

ways was so near the discovery, and why Harvey's later predecessors, such as Servetus and Columbus, who understood the lesser circulation, did not anticipate Harvey, Payne concludes that they lacked that peculiar high faculty of synthesis which is rightly regarded as an attribute of genius and closely allied to poetic imagination, and that, further, they were without the power of carefully verifying and proving the product of such an inspiration as Harvey so eminently did.

Passing over the dark ages let us glance at Harvey's more immediate predecessors. When a student at Padua from 1600[10] to 1602 Harvey came under the vivifying influence of the experimental method and the example of Galileo and others, and incidentally it may be noted that the chief claims for priority in the discovery of the circulation have been made on behalf of Italians; Hale-White,[11] however, has recently argued that the teaching of his senior contemporaries in England, William Gilbert (1540–1603) and Francis Bacon (1561–1626), must have stimulated Harvey to use the experimental method.

Leonardo da Vinci (1452–1519), the universal genius and "forerunner" of so many subsequent discoveries, dissected more than a hundred human bodies and made experimental observations on the movements of the pig's heart. As he could not see them, he emphasized the invisability of Galen's pores in the interventricular septum, but did not deny their existence, and, as Bayliss[12] pointed out, realized that the blood is driven into the arteries by the heart. His projected work on anatomy and physiology never saw the light; but his observations on the function of the valves of the heart and various points in which he made advances on current knowledge and departed from the Galenic tradition, have in comparatively recent times been dug out of his notebooks and drawings.

Michael Servetus, born in Villanueva in Spain in 1509, studied anatomy at Paris, and was a fellow-student and prosector with Vesalius under Joannes Guinterius (John Winter of Andernach, 1487–1574) and under Jacobus Sylvius (Jacques Dubois, 1478–1558); the latter, a bigotted follower of Galen, who subsequently spoke of Vesalius as a madman for his corrections of Galen's errors, must be distinguished from Franciscus Sylvius (Franciscus de la Böe, 1614–1672) of Leyden, who did for Harvey's views what Ambrose Paré had done for those of Vesalius. Servetus was an encyclopedist indeed, being a jurist, astronomer, meteorologist,

geographer, and medical man, but at heart a religious nonconformist, so that his interest in anatomy was merely a step to the knowledge of the spirit of man and so of God. He was a restless wanderer through Europe, continually getting into trouble as a reformer, until 1540, when he settled in practice at Vienne in Dauphine, hiding his identity under the name of Villeneuve. But, in 1553, he secretly had printed his *Restitutio Christianismi* at Vienne. This led to his trial, characterized, as Sir John Macdonnell[13] showed, by gross irregularities, at John Calvin's instigation; on October 27, 1553 he was burnt alive at Geneva, and with him practically all the thousand copies of his offending book. It is said that only three copies, two complete, one in Paris and the other in Vienna, and an incomplete one at Edinburgh, now exist. In it he clearly showed that he realizes the circulation through the lungs and wholly rejected the hypothetic passage of blood through the interventricular septum. This remarkable book, which though printed was never published, had been circulated in manuscript among his friends for some seven years before it was printed, as is proved by the existence of a draft, dated 1546, in the Bibliothèque Nationale (MS. Latin 18212), Paris (MacKall[14]); it is, therefore, quite possible, as Michael Foster[15] tentatively suggested, that Andreas Vesalius, the father of modern anatomy, may have seen the copy sent to Curio in Padua and so have been led to a more emphatic doubt of the transseptal passage of blood in the second edition (1555) of the famous *De Humani Corporis Fabrica* than was expressed in the first edition of 1543. According to Ceradini, however, Vesalius learnt the impermeability of the septum from his prosector, Columbus, in 1542. But, as Osler[16] in the charming account of Servetus points out, his discovery was unrecognized until, in 1697, William Wotton,[17] stimulated by Charles Bernard, surgeon to St. Bartholomew's Hospital, called attention to it. In the meanwhile Matheus Realdus Columbus (1516–1559) of Cremona, first pupil, then would-be supplanter and finally for one year successor of Vesalius at Padua, had left behind him a work, *De Re Anatomica* (published in 1559), which in the main is an inferior imitation of his teacher's *De Fabrica*, but contains a description, closely following that of Servetus, of the lesser circulation. As an explanation of this resemblance Chereau[18] propounded the surprising view that Servetus copied from Columbus, instead of the much-more-probable solution that, in spite of Ceradini to the contrary, Columbus borrowed the idea and the words from one of

the manuscript or printed copies of Servetus' *Restitutio Christianismi*. As bearing on this explanation, it may be mentioned that Columbus took as his own the description of the palmaris brevis muscle really given by Canano (*vide* Streeter[19]). Harvey, however, had not any knowledge of Servetus' book and refers with respect to Columbus on several occasions, speaking of him as "that skilful and learned anatomist."

Andreas Caesalpinus of Arezzo (1519–1603), professor of botany and medicine at Pisa (1555–1592), and later (1592–1603) at the Sapienza College at Rome, has also been regarded as the discoverer of the circulation. From an analysis of his medical writings, Michael Foster decided that he fully grasped the pulmonary circulation and had foreshadowed or even anticipated much that was afterward proved by demonstration about the systemic circulation. He was stoutly opposed to Galen and all his works, and while distinguished as a botanist was, like Servetus, much concerned with theological thoughts, being a theorist rather than an observer. His principal work, *Quæstionum peripateticarum Libri quinqui*, was published between 1571 and 1593, but his conceptions of the circulation did not attract any attention and were not adopted by Fabricius, professor of anatomy when Harvey was at Padua. In 1876 G. Ceradini, professor of physiology in the University of Genoa, put in a very patriotic claim for Caesalpinus as having not only entirely anticipated Harvey's discovery of the circulation but having gone even further and discovered the capillaries. Ceradini's view was adopted by L. Luciani[20] (1840–1919), the distinguished professor of physiology at Rome, but had in the meanwhile called forth a vigorous reply from R. Willis (in his *William Harvey*, 1878) and Sir George Johnson (Harveian Oration, 1882). The latter rather sternly turned the tables on Ceradini by concluding in the following words: "The best piece of criticism in Dr. Ceradini's book is that to be found at the commencement of the first chapter, in which, after referring to a tablet in the Veterinary Institute of the University of Bologna, attributing to Carlo Ruini the discovery of the circulation of the blood, he mercilessly exposes the plagiarisms of Ruini and demonstrates the utter absurdity of the attempt to make of him a great discoverer." Thus is brought to our notice another candidate for priority, but of his claims and thus of some others, such as Walter Warner,[21] the editor in 1631 of Harriott's *Algebra*, Protheroe, and Honoratus Faber, no serious notice is required. A

claim for priority has also been made on behalf of Petrus Paulus Sarpi (1552–1623), the Servite, philosopher and theologian of Venice, who did much dissection between 1582 and 1585, particularly on the eye, and was quoted by Fabricius, who sopke of him as "the Oracle of the age" in respect to knowledge, both general and of minerals, metals and anatomy; according to Thomas Cornelius Consentinus, Sarpi came to conclusions identical with those later set out by Harvey, and communicated them to Fabricius, who, though not thinking them of value, told Harvey about them. After Sarpi's death a manuscript account of these views was found and was said to have been seen by Vesling, but the document is not forthcoming and, as Miss Campbell[22] said in her appreciative life of Sarpi, until this account is discovered there is no proof that he wrote on the circulation. The suggestion made that the document found after Sarpi's death, in 1623, was only a transcript of the *De Motu* (1628) is obviously fallacious. Sarpi's reference to "a diabolical secret" has been thought by Tollin to refer to the description of the pulmonary circulation by Servetus, who would have been regarded by Sarpi as a heretic and the confidant of the devil. But this is hardly compatible with what is now known of Sarpi's character. A claim has also been made for Bhava Misra (A.D. 1550) of Benares, as having mentioned the circulation in his voluminous work on anatomy physiology, medicine, surgery and treatment.

Hieronymus Fabricus[23] (1537–1619), called from the place of his birth in Tuscany ab Aquapendente, succeeded his teacher Falloppius in the chair of anatomy at Padua in 1565 and occupied it until 1603; among other works he wrote *De Venarum Ostiolis* (1603, Padua), which shows that he observed the valves in the veins in 1574, four years before Harvey's birth in 1578 at Folkestone. These valves, however, had not entirely escaped the notice of Fabricius' predecessors. In his recent historical survey of this subject Franklin[24] brings forward evidence, as did Haller and Morgagni long ago and Cushing and Streeter[25] in 1925, to show that they were observed and investigated by Johannes Baptista Canano of Ferrara (1515–1579) between 1536 and 1546, when he communicated it to Vesalius, but never left any written account of his discovery, and that if Vesalius had verified, accepted, and recorded this observation in the *De Fabrica* in 1555, the world might not have had to wait until 1628 for Harvey's publication. As events turned out, Canano's observation, published in a rather unsatisfactory manner by Amatus

Lusitanus in 1551, was discredited by Vesalius, Eustachius, and Falloppius. The first published illustrations of the venous valves were those of Salomon Alberti in 1585, who acknowledged his indebtedness to Fabricus. Others who have been credited with the discovery are Charles Etienne, who according to Cushing and Streeter made the observation in 1538 and published it in 1545; the claim for Sylvius of Paris, put forward by Riolan, is very dubious (Franklin), though his *Isogoge*, published in 1555, nine years after Canano made the cummunication to Vesalius, contains a lucid account of the valves (Streeter); the same appears to hold good with regard to Fra Paolo Sarpi (1582). But the existence of the venous valves was forgotten until Fabricius gave his account of them with figures of the veins in the arm tied for bleeding and showing the position of the valves, which were afterward modified by Harvey in his well-known diagrams in the *De Motu* to show the use of the valves; in his later years Harvey told Robert Boyle[26] that the position of the valves in the veins suggested to him the circulation of the blood.

Gasparo Aselli (1581–1626) of Cremona, in 1622, published at Milan a book, *De Lactibus sive lacteis Venis*, describing the lacteals. Harvey has been said to have turned a blind eye on this discovery and not to have paid proper attention to the lymphatics. In letters to Dr. R. Morison of Paris and Dr. J. D. Horst of Hesse Darmstadt, written in 1652 and 1655, Harvey explains that before Aselli's book appeared he had observed these vessels, but after experiment and thought could not agree that they conveyed chyle from the intestines, as the fluid in them seemed to be the same as in the ducts of the mammary glands; with regard to the description of the thoracic duct and the receptaculum chyli, in 1651, he expressed his admiration of Jean Pacquet and others for their "singular industry in searching out the truth," but pleaded that his advanced years (being seventy-three years of age when Pecquet's book was published) and the infliction of "more and more indifferent health" rendered it impossible for him to go thoroughly into the question. The priority of the description of the lymphatic system is not entirely without question, for Erasistratus and Herophilus are stated to have observed the lacteals, though this was long forgotten, and Eustachius[27] (*Opuscula Anatomica*, Venetiis, 1564) is also said to have recognized the thoracic duct. Their discovery and that of the

thoracic duct supplemented Harvey's, though not so vitally as the demonstration, by the lenses of a microscope, of the capillaries.

Reception of Harvey's Discovery by his Contemporaries. The appearance of the *De Motu Cordis*, in the words of the great Albrecht von Haller (1708–1777), "Opusculum aureum," does not appear to have excited any immediate sensation or written notice. Many, perhaps, shrank from any disturbance of their comfortable acquiescence in the traditional doctrines of Galen, from the unpleasant experience of thinking, and if thus converted from laying themselves open to the accusation of heresy. Some, even, of Harvey's colleagues at the College of Physicians, who had long been more or less familiar with his views from attending his lectures and demonstrations there, may not have regarded him very seriously, and thought of him with kindly pity as a good man with an obsession. This, indeed, would be compatible with the attitude of Thomas Winston (1575–1655), who was praised by Meric Casaubon as "the great ornament of his profession," and incidentally is said, though this certainly seems rather surprising, to have been, with Simeon Fox and John Argent, both many times president of the Royal College of Physicians, the last physicians to visit their patients in London on horseback (Wadd[28]); not only was he Harvey's (1578–1657) almost exact contemporary and a Fellow of the Royal College of Physicians, where in later years their names came next to one another in the list, but he was professor of physic at Gresham College from 1613 to 1655 (with an interval of mysterious absence in France between 1643 and 1652), while Harvey was Lumleian lecturer at the College for the space of the forty years (1615–1655). Winston, as censor at the College (1622–1624, 1630–1632, 1634–1637), should often, if he acted like the censors of the present day, have attended Harvey's lectures and demonstrations on the circulation of the blood. Winston's *Anatomy Lectures at Gresham College*, which appeared posthumously in 1659, dutifully follow the Galenic doctrines and, though there are many references to more recent writers, especially Columbus and Riolan, scrupulously refrain from any mention of his colleague's *De Motu Cordis* and demonstrations of the circulation.

After the publication of Harvey's discovery, though it may have at once exercised the minds of some anatomists, there was, at any rate outwardly, a calm for some two years. The first ripple of the coming storm was the appearance, in 1630, of *Exercitationes et Animadversiones in Librum Gulielmi Harvaei de Motu Cordis et*

Circulatione Sanguinis, the maiden production of an afterward voluminous Scot of French birth, James Primrose; on December 9, 1629, he had been examined and passed as a licentiate of the College of Physicians by Harvey, then a censor, so this ungracious means of attracting attention to his existence is all the more remarkable. As a pupil of Riolan in Paris he had probably been inspired with opposition to any departure from Galenic piety, and Harvey, who may have realized this, naturally did not take any notice. Nothing daunted, Primrose returned to the charge, in 1639 and 1640, by entering into a controversy with J. Walaeus (Jan de Wale) on account of the thesis presented by his pupil, Roger Drake, in 1640, in support of Harvey's views, and also with LeRoy (Regius). Waleus, it may be mentioned, first opposed Harvey on theoretical considerations, but, when urged by Sylvius of Leydon, investigated the subject by way of experiment, and thus proved himself one of the best physiologists and a worthy follower of Harvey (*vide* van Leersum[29]). Primrose, in 1638, brought out a book which, although in Latin, was perhaps intended "for revenue purposes," *On Popular Errours or the Errours of the People in Physick*, tranlated into English in 1651 by Robert Wittie, M.D., Cambridge, who practised at Hull, as did James Primrose, until his death in 1659. It relies on the true faith of Galen and the Fathers, and does not mention the circulation of the blood, though several chapters deal with venesection. The attack made on Harvey by Aemylius Parisanus of Venice in 1635, in his *Lapis Lydius de Motu Cordis et Sanguinis*, led Sir George Ent (1604–1689) to defend his senior colleague in 1641 in his first printed work, *Apologia pro circulatione Sanguinis, Qua respondetur Aemylio Parisano Medico Veneto;* had it not been for Ent's book "the pugnacious old man," as Vesling eventually called Parisanus, would be even less known than he is now. Ent was a loyal Harveian, and later described himself both as performing the office of a midwife and "like another Jason" when in 1650 he was allowed to carry off Harvey's manuscript of *De Generatione Animalium* with permission to give it to the expectant world. Within ten years of the publication of the *De Motu* the controversy had become more widespread; Caspar Hofmann of Nuremberg (1636) and Joannes Vesling (1637) of Padua protested against Harvey. In 1636 Harvey accompanied Thomas Howard, second Earl of Arundel and "Father of Vertu in England," on his political mission as Ambassador Extraordinary to the Emperor Ferdinand, II at Vienna,[30]

and while staying on the way at Nuremberg attempted to convince Caspar Hofmann (1572–1648), his fellow-student at Padua, by demonstration of the truth of the circulation on May 20; but Hofmann, with the rigid mind due to thickened arteries which shortly afterward were responsible for his paralysis, was obstinate in his adhesion to the ancient faith, and charged Harvey with having "empeached and condemned Nature of folly and error." Vesling, however, after communication with Harvey was less set in his opposition; Vopiscus Fortunatus Plempius (1601–1671) of Louvain also began by dissenting, and then openly transferred his allegiance to Harvey. As already mentioned, Roger Drake (1608–1669), an Englishman educated at Cambridge, was inspired by J. Walaeus to read his inaugural dissertation, *Disputatio de Circulatione naturale*, at Leyden in 1640 in support of Harvey, and thus as well as his master became engaged in a wordy warfare with James Primrose, whom he answered with great effect in his *Vindiciae contra Animadversiones D. D. Primirosii* in 1641. Five years later he forsook physic for the cure of souls and wrote some theological works. Regius, as already mentioned, had a literary combat with Primrose in 1640. René Descartes (1637), Werner Rolfink (1641), professor of anatomy at Jena, and P. M. Schlegel of Hamburg in 1650 supported the new conception. De Back's *Dissertatio de Corde* (1648) was enthusiastically dedicated to Harvey and thus helped to restore the balance of the opposition by his Dutch colleagues van Valkenburg, Heurnias and van der Linden. The most obstinate antagonism was manifested by Jean Riolan the younger (1580–1657), the well-known Parisian anatomist, who, like Winston, was almost exactly Harvey's equal in age and span of life, but very dissimilar in mental outlook, following the footsteps of his father, Jean Riolan (1546–1606), the dean of the Faculty of Medicine in Paris (1586–1587) and a court physician, as a member of the strictest sect of Galenists. In 1648 his *Enchieridium anatomicum et pathologicum* appeared, and while opposing Harvey's views set up a preposterous hypothesis of his own. Though hardly demanding a reply on its merits, it was the work of the head of the Paris school of anatomists, and Harvey took the opportunity in answering Riolan to develop his position further in his *Exercitationes duae anatomicae de Circulatione Sanguinis ad Joannem Riolan filium, Parisiensem peritissimum Anatomicorum Coryphaeum*, 1649, Cantabrigiæ. Riolan returned to the charge at once in *Responsio ad duas exercitationes anatomicas*

postremas Gulielmi Harvei de Circulatione Sanguinis, 1649, and again in *Opuscula anatomica varia et nova, imprimis de Motu Sanguinis ejusque Circulatione vera*, etc. From his letter on March 26, 1651, to M. P. Schlegel it appears that Harvey was preparing a further answer to Riolan, but felt that Schlegel's refutation of the fallacies of his former teacher were perhaps enough. At any rate no further riposte was forthcoming. Ceradini and Luciani express the rather remarkable opinion that Harvey owed his fame to the advertisement resulting from Riolan's opposition and accusations. The Paris school, including Gui Patin (1601–1672), followed the lead of Riolan until a second professor of anatomy in the person of Pierre Dionis (Obüt, 1718), also surgeon to the Dauphin, was appointed to the chair in the Jardin des Plantes by Louis XIV and taught the doctrine of the circulation, later writing *Anatomie de l'homme suivant la circulation du sang et les nouveaux decouvertes* in 1690. But the first Frenchman to accept the circulation was J. Pecquet[31] of Dieppe in 1641.

Nathaniel Highmore (1616–1685), a scholar of Trinity College (elected 1632), and D. M. Oxon, 1642, the year when Harvey came to Oxford after Edgehill, dedicated to him his first book *Corporis humani Disquisitio anatomica in qua Sanguinis Circulationem prosequutus est* (1651), and thus gave the best account of his master's discovery that appeared in contemporary works of a systematic character. In Cambridge, owing to the influence of Francis Glisson (1597–1677), who was Regius professor of physic (1636–1677), Harvey's views were accorded a proper support; John Wallis (1616–1703), the famous mathematician who studied anatomy and medicine as well as metaphysics, ethics, and physics when at Emmanuel College between 1632 and 1640, was the first to maintain in a public dissertation the circulation of the blood, though he never had any intention of entering on "the physic line." Later, with Glisson, he was one of the "Invisible" or Philosophical College which met at Gresham College and in 1662 became the Royal Society. Henry Power (1623–1668), whose only published work, *Experimental Philosophy* (1663), was the first English book dealing with microscopical observations, was a loyal supporter of Harvey. He was of Christ's College, Cambridge, was in frequent scientific correspondence with Sir Thomas Browne, and was a Fellow of the Royal Society, being with Sir Justinian Isham the first elected Fellow of that body on July 1, 1663. I am much indebted to Dr. Charles

Singer for a transcript of one of Power's unpublished papers (Sloane MS. 1343) in the Bristish Museum, in which there is a section written during Harvey's lifetime, in 1652, headed, "Circulatio Sanguinis Harveiana inventa ab Authore An. Dom. 1614," thus somewhat antedating the discovery. He writes: "Amongst all the rabble of his (Harvey's) antagonists wee see not one that attempts to fight him at his own weapon, that is, by sensible and anatomical evictions to confute that, which he has by sense and autopsy so vigorously confirmed." Power carried out and gives in detail a number of experiments on living animals to trace the course of the circulation and the action of the heart; he disproved the passage of the blood through the interventricular septum, confirms the pulmonary circulation, and by a process of logical exclusion after experiment was driven to assume the existence of capillaries, though he never saw them. He searched for, but could never find, any direct anatomosis between the arteries and the veins, in which Riolan, Cornelus ab Hogeland, Descartes, and LeRoy still believed.

In France, owing to the influence of Riolan seconded by Gui Patin, opposition to Harvey's views was more persistent than elsewhere; but before his death Harvey had the gratification of seeing that his discovery was gradually gaining general acceptance, especially in Holland and England. Molière's character of Thomas Diafoirus[32] in *Le malade imaginaire* (1673) was probably the last adversary of the doctrine of the circulation (Richet[33]), but it was not the last attack on Harvey; for a discordant note was sounded more than a hundred years later by the great William Hunter[34] (1718–1783) in his last days when in very poor bodily health: in remarking that the three great discoveries of modern times were the Western Hemisphere by Columbus, the constitution of the Solar System by Copernicus, and the circulation of the blood by Harvey, he gave first rank to Columbus, second to Copernicus, and depreciated Harvey on the ground that "so much had been discovered by others that little was left for Harvey but to dress it up into a system." But, as Herbert Spencer[35] remarks, this was probably written in a fit of temperamental contrariety, for elsewhere he speaks highly of Harvey. As already mentioned, Harvey's priority was attacked in 1876 by Ceradini on behalf of Caesalpinus.

Unfortunately Harvey did not live to see the final proof provided by the demonstration of the capillaries. In connection with Harvey's not having seen the capillaries, it is interesting to quote

D'Arcy Power[36] to the effect that a portrait of Harvey, dated 1639, shows in the background a microscope identical with the form of the compound microscope figured by Rene Descartes in his *La Dioptrique*, 1637. In 1661 Marcello Malpighi (1628–1694), born in the year of the publication of the *De Motu*, and therefore closely associated with this year's tercentenary celebration of the birth of physiology, utilized the microscope, probably invented in 1590 by Zacharias Joannides (Jansen) and his son, of Middelburg, Holland, and thus saw the capillaries in the distended and in the dried lung of a frog, and also the red blood corpuscles which, however, he regarded as fat cells. Antonj van Leeuwenhoek[37] (1632–1723) of Delft, "The Father of Microscopy," observed the capillaries in living animals in 1674, and correctly described the contained red blood corpuscles, saying that "the blood consists of small round globules driven through a crystalline humidity of water," and that the small red globules were heavier than the crystalline water; Johannes Swammerdam (1637–1680) of Amsterdam, also a pupil of Sylvius of Leyden, however, had seen the red blood cells as early as 1658, though his observation was not made public until 1738, when his *Bybel der Natuur* (*Biblia Naturæ*) was brought out by Boerhaave. Leeuwenhoek,[38] in an essay, "On the Circulation of the Blood; that it is not discoverable by sight in a human Body nor in the Bodies of terrestrial Animals; the same compleatly seen in Fishes, and the Nature of it particularly described," proved in 1688 the existence of the capillary circulation, which Harvey had deductively anticipated, by figuring the capillaries in the comb of a living young cock,[39] the ears of white rabbits, the wings of bats, in tadpoles, and the fins of small fish.

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HARVEY'S EXPERIMENTS ON CIRCULATION*

The Nathan Lewis Hatfield Lecture
Lecture VIII

By J. J. R. MACLEOD, M.B., LL.D., D.Sc., F.R.S.,
ABERDEEN, SCOTLAND.

When the news of a great advance reaches us from the battlefield our joy is coupled with praise and applause, not only for the general who led the forces but also for those whose silent labors going on, often for long before, made the victory possible. And so it is in science. The discovery of the circulation of the blood was based on many preceding discoveries, but these would have been useless and long since forgotten, and blotted from the pages of history, had they not been coördinated, added to and reinterpreted in the light of a new theory which was then established beyond all risk of attack by new experimental proof. This it was that Harvey so admirably did, and it is my pleasant duty this evening to go over with you again the familiar pages on which, three centuries ago, he put his great work on record. It is, as it were, a Bible to the physiologist and physician and we can honor its author in no better way than by reading from its pages.

The first thirteen chapters of *De Motu Cordis et Sanguinis* present in admirable sequence the observations and experiments which prove that the blood is impelled in a circle around the body. This conclusion and all that it implies is restated in the fourteenth chapter, which, in Willis' translation, reads as follows:

> Since all things, both argument and ocular demonstration, show that the blood passes through the lungs and heart by the force of the ventricles, and is sent for distribution to all parts of the body, where it makes its way into the veins and porosities of the flesh, and then flows by the veins from the circumference on every side to the center, from the lesser to the greater veins, and is by them finally discharged into the vena cava and right auricle of the heart, and this in such a quantity or in such a flux and reflux thither by the arteries, hither by the veins, as cannot possibly be supplied

* Read March 22, 1928.

by the ingesta, and is much greater than can be required for mere purposes of nutrition; it is absolutely necessary to conclude that the blood in the animal body is impelled in a circle, and is in a state of ceaseless motion; that this is the act or function which the heart performs by means of its pulse; and that it is the sole and only end of the motion and contraction of the heart.

We can scarcely realize the true significance of these few words until we contrast the conception of the circulation which they so clearly define with the obscure and fantastic one which it replaced: The blood (so Galen taught) originates in the liver, where it is produced through the influence of this organ acting on the food absorbed into the vena porta from the alimentary canal. This is crude blood, endowed only with natural spirits, and it is carried through the vena cava to the right side of the heart, between which and the great veins it then ebbs and flows so as to supply the tissues with the lower requirements of nutrition, some passing in like manner to the lungs by way of the artery-like vein (the pulmonary artery). But all of the crude blood does not behave in this manner; some passes through invisible pores in the septum into the left ventricle, where, under the influence of the innate heat of the heart, it becomes endowed with vital spirits, and then, as vitalized (arterial) blood, flows through the arteries to supply the tissues with the higher (vital) requirements of their nutrition, and the ventricles of the brain with blood, so that, with the addition of air, the animal spirits, highest of all, may be prepared, which then distil throughout the body by way of the nerves. In order to cool and temper the vitalizing fire which is lighted in the heart at birth and burns there until death, air drawn in from the lungs is carried to the left ventricle with the ebb tide of the blood through the vein-like arteries (pulmonary veins), and with its flow the fuliginous vapors engendered by the combustion are carried to the lungs.

Now, besides the fundamental difference between the old and the new viewpoints, expressed in words by "ebb and flow" and "circulation," there are at least two assumptions in the Galenic teaching with which Harvey had to deal: the one, that there are invisible pores in the septum; and the other, that a lifelong, vital fire burns in the left ventricle. The former of these Harvey cast aside as unnecessary, aided no doubt in his decision by the works of his predecessors, Columbus, Cesalpinus and perhaps even Michael Servetus; the latter he still clung to, for he believed with Aristotle:

> There must be a particular seat and fountain, a kind of home and hearth, where the cherisher of nature, the original of the native fire, is stored and preserved; from which heat and life are dispensed to all parts as from a fountain head . . . Now, that the heart is this place, . . . I trust no one will deny.

He conceived an important duty of the circulating blood to be the conveyance of heat from the heart to the peripheral parts of the body and, with this conception in mind, he still followed the ancients in imagining that the air which enters the lungs serves to cool and temper the vital fires of the heart.

When arguing that the blood must pass from the right to the left chambers of the heart by way of the pulmonary vessels, he writes, in the sixth chapter:

> Nature has (rather) chosen to make the blood percolate the parenchyma of the lungs . . . in order that it may be tempered by the air that is inspired, and prevented from boiling up, and so becoming extinguished, or something else of the sort.

But a note of skepticism is, I think, quite evident in these words. No one had ever conceived of any other possible source for the heat of the body than the viscera, especially the heart, for not only was the nature of fire itself a complete mystery, but even Van Helmont's idea that the tissues were the kitchens of the body was as yet unborn and Harvey was compelled to accept the Aristotelian viewpoint. He had ventured just as far as he dared in the light of observation and experiment, and he was too astute to jeopardize the acceptance of his main thesis by theoretical discussion of a problem which that light could not illumine.

I have directed your attention to these unfinished portions of the picture which Harvey gave us because I consider that they add to, rather than detract from, its priceless value. Like a great artist he was primarily concerned in conveying a message of truth, and he dared not allow this to lose its prominence in the picture by unconvincing argument over details which he could not clearly see in the then dim light of scientific knowledge.

And now I come to the most outstanding feature of Harvey's work, to the anatomical evidence and the experimental proof from which he drew his conclusions. How does this measure up with our present-day standards? Must we, as with many other of the older contributions to science, view Harvey's experiments merely

as stepping stones to something better, or are they final and beyond improvement or modification? I can best answer these questions by stating that I know of no system of practical instruction in the physiology of the circulation which compares in excellence with that which is sufficiently outlined in the chapters of Harvey's book, from the second to the thirteenth. Indeed I am of the opinion that were we to do little more than require our students of medicine of to-day to repeat, step by step and in their sequence, each of the dissections and experiments as laid down in *De Motu Cordis et Sanguinis* we should train them, in a general way better than at present, to think out for themselves the problems of the circulation. Other facts about the heart and circulation that Harvey never dreamed of would obviously have to be learned, but the method not only of supplying proof by observation and experiment, but also of thinking, would make the acquisition of these new facts an easy task.

The brevity of Harvey's treatise, and the apparent facility with which appropriate proof is found for each new fact as it is stated, may give the impression that his discoveries were revealed to him by some sort of Divine inspiration, rather than being what they were, the outcome of the most patient and repeated research, both anatomical and experimental, made upon animals from the lowliest which he could examine, upward through the scale, to man himself. Eclectic in his methods, Harvey made use of knowledge from whatever source. Everything that could possibly aid him in his search after truth was called into play, and were he among us to-day I imagine that he would deride with scorn the dissociation into subjects the specialization which features our medical teaching.

He writes at the very beginning of the book as follows:

> When I first gave my mind to vivisections as a means of discovering the motions and uses of the heart, and sought to discover these from actual inspections and not from the writings of others, I found the task so truly arduous, so full of difficulties, that I was almost tempted to think, with Fracastorius, that the motion of the heart was only to be comprehended by God.

And then, a little further on:

> At length, and by using greater and daily diligence and investigation, making frequent inspection of many and various animals and collating numerous observations, I thought that I had attained to the truth, that I should extricate myself and escape from this labyrinth, and that I had discovered what I so much desired, both the motion and the use of the heart and arteries.

But with all his success he did not lose the modesty of the true inquirer of nature; the more her secrets were revealed to him the more clearly did he see that beyond were multitudes of other problems, and he ends the first chapter with the verse:

> For never yet hath any one attained
> To such perfection, but that time, and place,
> And use, have brought addition to his knowledge;
> Or made correction, or admonished him,
> That he was ignorant of much which he
> Had thought he knew; or led him to reject
> What he had once esteemed of highest price.

The first problem to be attacked concerned the motions of the heart. How could he, "by reason of the rapidity of these motions," "rightly perceive at first when the systole and when the diastole took place?" Was Galen right in stating that "when the heart strikes the breast and the pulse is felt without, it is dilated in its ventricle and is filled with blood?" Do the arteries and the heart both dilate at the same time? To wring these secrets from the heart its movements had to be examined when they were "slower and rarer" than in the higher animals, and this Harvey found to be the case "in the colder animals, such as toads, frogs, serpents, small fishes, crabs, shrimps, snails and shell-fish," as well as in "warm-blooded animals, such as the dog and hog, if they be attentively noted when the heart begins to flag . . ." I need not here quote what Harvey then describes, his final conclusion being:

> [The heart] becomes erect, hard and of diminished size during its action, the motion is plainly of the same nature as that of the muscles when they contract . . . it is at once constricted on all sides . . . [so that] by squeezing out the blood it contains it becomes paler, and when it sinks into repose and the ventricle is filled anew with blood . . . the deeper color returns.

Having demonstrated the true nature of the motion of the heart and exposed the falsity of the "opinions commonly received," Harvey then leads us to the motions and pulses of the arteries:

> At the moment the heart contracts and when the breast is struck, when in short the organ is in its state of systole, the arteries are dilated, yield a pulse and are in a state of diastole [and] when an artery is divided or punctured the blood is seen to be forcibly propelled from the wound at the moment the left ventricle contracts.

The then current notion that heart and arteries contract and dilate together is thus overthrown, and Aristotle's observation that, "the blood of all animals palpitates within their veins (meaning the arteries) and by the pulse is sent everywhere simultaneously," is given its true meaning.

FIG. 1.—Early portrait of Harvey in oils, said to be by or after Rubens.

These relationships between the movements of the heart and arteries established, Harvey returns to a more particular analysis of the sequence and purpose of the former. By observing the dying heart of mammals, and the heart of fishes, he brought to light two supremely important facts, namely, that the motion of the auricles

precedes that of the ventricles and that the pulsations depend on a property of the cardiac muscle itself. If the heart of the eel be cut in pieces, he says, the several parts may still be seen pulsating and palpitating. He forestalls the modern teaching that "the auricle

EXERCITATIO
ANATOMICA DE
MOTV CORDIS ET SAN-
GVINIS IN ANIMALI-
BVS,
GVILIELMI HARVEI ANGLI,
Medici Regii, & Professoris Anatomiæ in Col-
legio Medicorum Londinensi.

FRANCOFVRTI,
Sumptibus GVILIELMI FITZERI.
ANNO M. DC. XXVIII.

Fig. 2.—Title page of first edition of De Motu Cordis.

is the pacemaker of the heartbeat," that it dominates the ventricular beat. And then he discusses the purpose of this sequence of beating; the auricle contracts first, so that "the blood enters the ventricles, not by any attraction or dilatation of the heart, but by being thrown

into them by the pulses of the auricles." The ventricles do not become filled with blood by dilating like a sponge after it has been squeezed, but passively, by blood propelled into them by contraction of the auricles, for "if . . . the point of the heart [ventricle]

Excellentiſs⁰ & Ornatiſſ. Viro D.

D. ARGENT,

COLLEGII MEDICORVM

LONDINENS. PRÆSIDI AMICO SVO

ſingulari cæteriſq; Doctiſſ. Medicis

Collegis ſuis amantiſſ.

S. P. D.

MEam de motu & vſu cordis, & circuitu ſanguinis ſententiam E. D. D. antea ſæpius in prælectionibus meis Anatomicis aperui novam: ſed iam per nouem & amplius annos multis ocularibus demonſtrationibus in conſpectu veſtro confirmatam, rationibus & argumentis illuſtratam, & ab obiectionibus doctiſſimorum & peritiſſimorum Anatomicorum liberatam, toties ab omnibus deſideratam, à quibuſdam efflagitatam, in lucem & conſpectum omnium hoc libello pro-

A 3 duximus

FIG. 3.—Preface of De Motu Argent.

be cut off with a pair of scissors" when the auricles are alone pulsating (as in a dying heart), "you will perceive the blood flowing out upon each contraction of the auricles."

Impressed with the persistence of beating in the auricles, or rather,

as he says, in "the part which corresponds to the auricles in serpents, fishes, etc.," Harvey enters into a discussion of the "*primum vivens*" and the "*ultimum moriens.*" It is not the heart as a whole but the auricles which "live before the heart and die after it;" and perhaps it is even deeper down, as it were, and resident in the blood itself, for he "occasionally observed after the heart, and even the right auricle, had ceased pulsating . . . that an obscure motion,

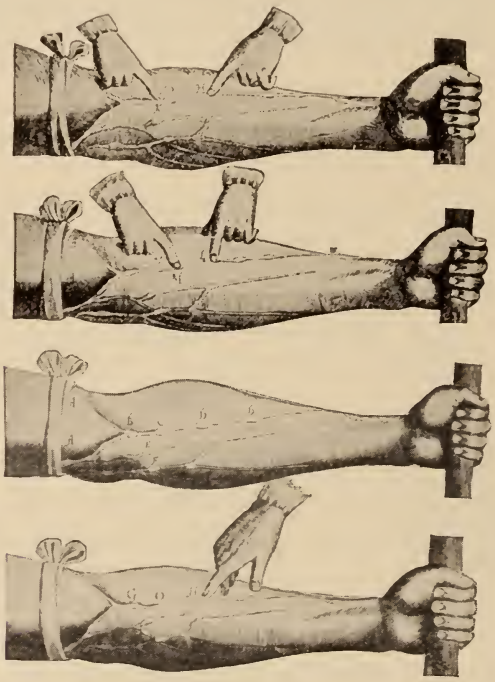

Fig. 4.—Harvey's four figures illustrating experiments on the direction of the blood-flow in the veins.

an undulation or palpitation, remained in the blood itself which was contained in the right auricle." He also repeatedly refers to the fact, as Aristotle had before him, that in the chick embryo "a drop of blood makes its appearance [during the first seven days of incubation], which palpitates," and from which "as the growth is further advanced and the chick is fashioned, the auricles of the heart are formed . . ." Here, I think, Harvey is making an attempt to harmonize the then prevailing muddled ideas of the

innate heat of the blood with the remarkably clear analysis which he had achieved of the motions of the heart. Aristotle had taught the primacy of the heart; Harvey, though his disciple in most things, taught the primacy of the blood. Even in his earliest lecture notes, in 1616, are passages which are not in accord with the ancient philosopher's teaching. "The soul is in the blood," he writes, and again "because of the abundance of blood and spirits in the ventricles whence the fount of the entire heat . . . and whence the auricles pulsate, after removal of the heart, because of the multitudinous blood." And in his last publication, in 1651, he finally decides that "pulsation is begun in and by the blood, so at last it

Fig. 5.—Engraving of Harvey's Demonstration to King Charles I.

ends in the blood at the final instant of death" (*On Generation*). He never questions Aristotle's doctrine, that the first part to live is always the last part of the body to die. Curtis, in his scholarly analysis of the views of Harvey, considers that fibrillation of the auricular walls misled him into thinking of "an obscure motion and flow" of the blood itself, a notion which was confirmed in his mind by the "leaping point" of blood in the embryonic chick.

But we must return to the experimental proof of the circulation of the blood. Having concluded that the blood is propelled from auricles to ventricles, and thence through the arteries to the body, it remained to explain how it is transferred from the right to the

left side of the heart. Herein was the great puzzle of the circulation, "the grand cause of doubt and error:"

When men saw both the pulmonary artery and the pulmonary veins losing themselves in the lungs, of course it became a puzzle to them to know how, or by what means, the right ventricle should distribute blood to the body or the left draw it from the venæ cavæ.

Fig. 6.—Title page of Pulleyn's Edition of Harvey's De Generatione Animalium.

Then, in the sixth and seventh chapters, it is shown, first of all by dissections and vivisections on lower animals and then by consideration of the course of the blood in the fetus of the higher ones, how in man the blood must pass through the substance of the lungs

from the right ventricle of the heart into the pulmonary veins and left ventricle:

> Had anatomists [he writes] only been as conversant with the dissection of the lower animals as they are with that of the human body, the matters which have hitherto kept them in a perplexity of doubt would in my opinion have left them freed from every kind of difficulty.

EXERCITATIONES
DE
GENERATIONE
ANIMALIVM.
Quibus accedunt quædam
De Partu: de Membranis ac humoribus Vteri: & de Conceptione.
AVTORE
GVILIELMO HARVEO ANGLO,
in Collegio Medicorum Londinensium
Anatomes & Chirurgiæ Professore.

AMSTELODAMI,
Apud Ludovicum Elzevirium.
cIↃ IↃC LI.

FIG. 7.—Title page of the Elzevir edition of Harvey's De Generatione Animalium

He begins with fishes, in which, the lungs being absent, the heart consists of but a single ventricle into which the blood is projected by the contraction of a sac, representing the auricle, situated at its base, whence it is propelled by each pulsation of the heart into a pipe analogous to an artery. A little higher in the animal scale, in

toads, frogs, serpents and lizards, lungs appear and into these "anatomical dissection plainly shows that the blood is transferred . . . by the action of the heart," which, in having but one ventricle, acts precisely as it would in man if the septum were removed. Then follows a discussion of the human fetal circulation, in which it is shown—by observing the free pathways to bloodflow afforded by the foramen ovale and ductus arteriosus, and the blocked

FIG. 8.—Portrait of Harvey in skull cap.

ones when the valves at the foramen ovale and large arteries are closed—that most of the blood does not enter the lungs:

> In embryos, consequently, whilst the lungs are yet in a state of inaction . . . the heart by its action transfers the blood from the vena cava into the aorta . . . as if in the adult the two ventricles were made to communicate by removal of their septum.

Here is a classical example of the value of comparative physiology: first fishes, then toads and serpents, then the human fetus, all showing a similar type of circulation associated with a more or less undeveloped or unused lung; a circulation entirely different from that set going after birth in man. Why should nature "close up the various open routes which she had formerly made use of in the embryo and fœtus, and still uses in all other animals?" It must be

"in order that it [the blood] may be tempered by the air that is inspired." It must circulate through the parenchyma of the lungs in adult animals because the more direct passages previously open to it by way of the foramen ovale and ductus arteriosus are now closed. Harvey recognized that the fetal openings may remain open in certain warm-blooded animals, such as geese and "in one of the larger members of the mouse family," and that they may sometimes fail to close completely even in man himself.

But now arose the difficulty of explaining how the blood could pass continuously from the pulmonary artery through the lungs into the pulmonary veins. There were no visible anastomoses between these two vessels in the lungs, and capillaries were unknown. Harvey's attack on this problem was an indirect one; he had, as it were, to outflank the difficult position which the enemy to progress still held, because it had to be shown that the whole mass of blood of the body passes through the substance of the lungs "even as the nutritive juices percolate the liver." The last sentence indicates the direction of the attack. When large amounts of liquid are imbibed all "passes off again within an hour or two by the bladder" and must therefore percolate the liver, and, carried by the veins (bloodvessels), must pass through the kidneys into the ureters and bladder. But the substance of these organs is extremely dense, whereas "the lungs are of a much looser texture and if compared with the kidneys are absolutely spongy." In the liver, moreover, there is no impelling on (of the blood); in the lungs it is forced on by the pulse of the right ventricle. "And then the lungs in respiration are perpetually rising and falling; motions, the effect of which must needs be to open and shut the pores to vessels precisely as in the case of a sponge."

He then calls to his assistance the authority of Columbus with regard to the fulness of the pulmonary veins with blood after death, and of Galen concerning the uses of the valves of the heart and bloodvessels. But whereas the latter, having regard only to the two sets of valves in the right heart, had only concerned himself with "the transit of the blood . . . from the vena cava through the ventricles into the lungs," Harvey, having regard to those of the left heart as well, concluded "that the blood is incessantly sent from the right ventricle into the lungs by the pulmonary artery, and in like manner is incessantly drawn from the lungs into the left ventricle," so that "it cannot do otherwise than pass through continu-

ously." Then, in summing up these arguments in the last paragraph of the seventh chapter, he writes:

> It therefore appears that although one ventricle of the heart, the left to wit, would suffice for the distribution of blood over the body, and its eduction from the vena cava, as indeed is done in those creatures that have no lungs, nature, nevertheless, when she ordained that the same blood should also percolate the lungs, saw herself obliged to add the right ventricle, the pulse of which should force the blood from the vena cava through the lungs into the cavity of the left ventricle.

The right ventricle is made for the transmission of blood through the lungs and not, as the ancient teaching was, merely for their nutrition.

The new position having been gained, everything was now in place to launch the grand attack on the old doctrines of the ebb and flow of the blood in the arteries and veins. Here the attack must venture forth with no more assistance or guidance from the work of preceding anatomists than that offered by Fabricius concerning the valves in the veins. Men's minds were to some extent prepared to receive the new teaching in so far as concerned the pulmonary circulation, for had not even Vesalius, influenced perhaps by Servetus' writings, cast some doubt on the supposed existence of pores in the septum; and had not Columbus, reflecting, it is thought, the teachings of others, actually declared the passage of blood through the pulmonary circuit? "But what remains to be said upon the quantity and source of the blood which thus passes is of a character so novel and unheard of" that Harvey feared that he should have "mankind at large for his enemies. . . . Doctrine once sown strikes deep its root and respect for antiquity influences all men."

Reflecting on his numerous studies of the ventricles, of the large vessels, the relative thickness of their walls and on the disposition of the valves of the heart:

> [He asked himself] what might be the quantity of blood which was transmitted, in how short a time its passage might be effected and the like. [The volume of blood could not be supplied from the ingested aliment] without the veins on the one hand becoming drained and the arteries on the other getting ruptured through the excessive charge of blood, unless the blood should somehow find its way from the arteries into the veins and so return to the right side of the heart; I began to think whether there might not be *a motion, as it were, in a circle.*

With what follows in the eighth chapter about the heart being the sun of the microcosm, the source of heat for the blood and body, we need not here concern ourselves. Of much greater importance are the proofs presented in the succeeding five chapters. Three propositions had to be considered: the first, that "the blood is incessantly transmitted by the action of the heart from the vena cava to the arteries in such quantity that it cannot be supplied from the ingesta;" the second, that the blood is impelled by the arterial pulse through every part and member of the body; and the third, that the veins return this blood incessantly to the heart.

First, then, Harvey had to show that the quantity of blood thrown into the aorta is far in excess of what could possibly come from the ingesta, and this he proceeds to do by quantitative methods. Having found that the left ventricle when distended after death holds upward of 2 ounces of blood, and assuming for sake of argument "that but the eighth part of its charge is thrown into the artery," then at least 1 dram of blood must be "propelled by the heart at each pulse into the aorta," and multiplying this by the number of beats in a given period of time, say 1000 in half an hour, we shall have 1000 drams, which is a larger quantity, even on this absurdly low estimate, "than is contained in the whole body." "Upon this supposition, therefore, assumed merely as a ground for reasoning, we see the whole mass of the blood passing through the heart from the veins to the arteries and in like manner through the lungs." In this method of attack we see that Harvey left no loophole through which his critics might assail his position. Would he not have been surprised if he had known, as we do now, that nearly thirty times a dram of blood is thrown into the aorta with each contraction of the heart, and that the very largest amount which he mentions, 2 ounces, would still have been but little more than one-half that actually ejected? But he is careful to point out that the quantity of blood being circulated is not always the same, for he says: "the blood is transfused at one time in large, at another in smaller quantity . . . now more rapidly, now more slowly, according to the temperament, age, etc., of the individual," and he recognized that rest and exercise and food have potent influences.

And then follows the corollary: If the blood thus circulates, then it must soon all be drained out of the body by opening a vessel. This need not be the great artery, the aorta, but a very small branch only, and the blood "spouts forth with force abundantly, impetu-

ously and as if it were propelled by a syringe," whereas when a vein is opened but very little blood is poured out, because its walls collapse and there is no propelling power. Moreover, when an artery only is opened the veins become emptied of blood coming through the heart, but "if the aorta be tied at the base of the heart and the carotid or any other artery be opened, no one will now be surprised to find it empty and the veins only full up with blood." Then finally this all harmonizes with the long-known fact that the arteries are empty and the veins replete with blood after death, for:

> The heart not ceasing to act at the same precise moment as the lungs, but surviving them and continuing to pulsate for a time, the left ventricle and arteries go on distributing their blood to the body at large and sending it into the veins; receiving none from the lungs, however, they are soon exhausted and left, as it were, empty.

In the tenth chapter an experiment is described which every student of medicine should be made to perform. When the vena cava of a snake is occluded, the part that intervenes between (the occlusion) and the heart almost immediately becomes empty, the blood being exhausted by the action of the heart, which itself becomes paler, even when it is dilated, is smaller and at last begins to beat more slowly as if it were about to die. Remove the obstruction:

> [And] instantly the colour and size of the heart are restored. . . . If on the contrary the artery instead of the vein be compressed or tied you will perceive the part between the obstacle and the heart and the heart itself to become immediately distended, to assume a deep purple or even livid colour . . . but the obstacle removed, all thing immediately return to their natural state in colour, size and impulse.

The proof for the second proposition, that the blood is carried throughout the body by the arterial pulse, is likewise furnished by experiments well worthy of repetition in our practical classes demonstrating the effects of ligatures.

> Let a ligature be thrown about the extremity [preferably of a lean man with large veins and after exercise], and drawn as tightly as can be borne, it will first be perceived that beyond the ligature . . . the arteries cease to pulsate . . . whereas immediately above the ligature . . . the artery appears as if it were preternaturally full. The hand, retaining at first its natural colour and appearance, in the course of time begins to fall somewhat in its temperature . . . Now let the ligature be par-

tially slackened, to the tension used in blood letting [and] it will be seen that the whole hand and arm will instantly become deeply coloured and distended and the veins show themselves turgid and knotted [and] if the finger be applied over the artery as it is pulsating by the edge of the fillet, at the moment of slackening it, the blood will be felt to glide through, as it were, underneath the finger; and he, too, upon whose arm the experiment is made, when the ligature is slackened, is distinctly conscious of a sensation of warmth and of something making its way along the course of the vessels and diffusing itself through the hand.

We need not occupy our time with further reference to these experiments, so easily understood nowadays, except to show how Harvey used them to prove that the arterial blood passes into the veins by certain porosities hidden in the tissues. The blood, he concludes, cannot flow into the arm by the veins when a ligature of medium tightness is applied, because the blood cannot be forced toward the heart until the ligature is removed, when suddenly all the veins collapse:

[The subject] is aware of something cold making its way upward along with the returning blood and reaching the elbow or the axilla . . . Farther, when we see the veins below the ligature instantly swell up and become gorged when, from extreme tightness, it is somewhat relaxed, the arteries meantime continuing unaffected, this is an obvious indication that the blood passes from the arteries into the veins and not from the veins into the arteries and that there is either an anastomosis of the two orders of vessels or porosities in the flesh and solid parts generally that are permeable to the blood.

A great merit of Harvey's researches lay in the admirable correlation of the purely experimental and the clinical. He did not, like so many of his time, seek for some pseudoscientific explanation for disease; he was no schoolman with a favorite hypothesis to defend, with a panacea for all ills. Although neither an iatrophysicist nor an iatrochemist, he nevertheless lost no opportunity to point out the application in the practice of medicine of what his researches had revealed to him. We can find no better example of this feature of Harvey's work than the application in the practice of phlebotomy of the principles we have just reviewed. Thus, he points out that sudden failure of blood to flow freely from the opened vein, the ligature being nevertheless applied with the proper degree of tightness, is due to languid pulsation of the heart, occasioned perhaps by some alarm, the reason being "that with some greater than usual

resistance offered to the transit of blood by the bandage, coupled with the weaker action of the heart and its diminished impelling power, the stream cannot make its way under the ligature." He never actually speaks of blood-pressure, it was not until nearly a century later that Stephen Hales demonstrated this, but Harvey realized that it existed (impelling power) and that its insufficiency was the cause of fainting.

To prove the third proposition, that the blood finds its way back to the heart from the periphery by the veins, Harvey made use of his old Paduan teacher's discoveries of the valves of the veins. He first of all reviews Fabricius' description of the arrangement and disposition of the valves and then points out that they could not, as their discoverer had imagined, exist merely for the purpose of hindering the blood from flowing by gravity into inferior parts, because "the edges of the valves in the jugular veins hang downward and are so contrived that they prevent the blood from rising upward" nor could the effects of gravity be invoked to explain the disposition of many of the valves in the veins of quadrupeds. "But the valves are solely made and instituted lest the blood should pass from the greater into the lesser veins." A probe can readily be pushed past the valves when it is directed from the smaller branches toward the trunk of the veins, but not in the opposite direction. "The effect of this arrangement plainly is to prevent all motion of the blood from the heart and vena cava whether it be upward toward the head or downward toward the feet."

But Harvey never based his proof on anatomical reasoning alone, however compelling this might be; it was always supplemented by experimental evidence. In the present instance this consisted in an admirable series of simple experiments performed on the veins of the forearm after applying a ligature at the elbow. You are doubtless all familiar with the famous figures illustrating these experiments. The first one shows the valvular bulgings and their frequent relationship to the branchings; the second, how the vein disappears from view when, with one finger compressing it below, the blood is pressed upward until a valve is reached; the third, how downward pressure on the distended vein above this valve serves only to make the portion of the vein between the finger and the valve become more distended; and the last, how the obliterated portion of vein refills instantly with blood when the lowermost finger is withdrawn. And even by the use of simple experiments of this type Harvey

shows how one may arrive at an estimate of the amount of blood flowing in the vessels:

> [He says] compute the quantity of blood which you have pressed up beyond the valve [by repeating the second and fourth of the experiments] and then multiplying the assumed quantity by one thousand, you will find that so much blood has passed through a certain portion of the vessel; and I do now believe that you will find yourself convinced of the circulation of the blood and of its rapid motion.

A STATISTICAL STUDY OF CLINICAL AND LABORATORY FINDINGS IN GASTRIC AND DUODENAL ULCER, WITH SPECIAL REFERENCE TO ROENTGENOLOGIC DATA.*

Based on the Records of 279 Operatively Demonstrated Cases.

By T. GRIER MILLER, M.D., EUGENE P. PENDERGRASS, M.D.

and

KATHERINE S. ANDREWS, M.D.

(From the Gastro-intestinal Clinic and the Roentgenologic Department of the Hospital of the University of Pennsylvania.)

Introduction. Gastric or duodenal ulcer has been demonstrated at operation in the hospital of the University of Pennsylvania during the past ten years on 279 patients. Many other individuals, diagnosed as having ulcer but not subjected to surgery, have been studied in the medical wards and the roentgenologic department. The present study was initiated with the idea of summarizing and correlating the important data on all the operatively proved cases, but as the work progressed it became apparent that some of the desired information was lacking in many of the records, and that, since under such circumstances each collection of statistical material would represent a different group of patients, it would be impossible to compare accurately the histories, the gastric analyses, the roentgenologic data and the operative findings. In consequence, it was decided to use the entire series only for certain special groups of data, such as the sex and age incidence and the duration of symptoms, and to select for the particular study of symptoms, signs and laboratory data only those cases on which the clinical records were very complete and on which the operative notes were reasonably satisfactory; this latter group includes 36 gastric and 100 duodenal cases. Though the number may be considered too small to have

* Read April 4, 1928.

great statistical value, much is gained by the thoroughness with which each case has been studied and the accuracy with which the various groups of data may be compared.

Relative Incidence. The assembled data are presented in the accompanying tables and charts which are largely self-explanatory. Table I shows that the duodenal ulcer cases far outnumber the gastric ones (221 to 58) in the ratio of almost 4 to 1. This relationship is approximately that of the larger surgical clinics. In Moynihan's[1] series of 695 operated ulcer cases, reported in 1923, 531 were duodenal. Until recent years, textbooks stated that gastric ulcers outnumbered duodenal ones, but now almost all statistics quoted indicate the reverse condition and explain the error of former compilations as due to faulty clinical diagnoses and to a failure of pathologists to examine carefully the duodenum for ulcers and scars. A recent publication by Sturtevant and Shapiro,[2] however, shows that in 7700 autopsies performed at the Bellevue Hospital between 1904 and 1922 more healed and unhealed gastric than duodenal ulcers (120 to 44) were found. The discrepancy between the necropsy and the operative data would seem to be due to the fact that a smaller number of the gastric lesions give rise to symptoms requiring surgical treatment. It is probable, indeed, that many of the gastric cases present no symptoms whatever, since in an analysis of the roentgenologic records, which more nearly represent the total number of patients with ulcer symptoms, Sutherland,[3] of the Mayo Clinic, found an even greater preponderance of duodenal lesions (9 to 1).

Table I.—Sex of Ulcer Cases

	Gastric.		Duodenal.		Two groups.	
Sex.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Male . . .	52	90	188	85	240	86
Female . . .	6	10	33	15	39	14
Total . .	58	100	221	100	279	100

Sex Incidence. In the sex distribution, which is presented in the same table, it will be noted that 90 per cent of the gastric ulcers and 85 per cent of the duodenal ulcers occurred in men. The preponderance of duodenal ulcer in the male is well recognized, but it is commonly stated that gastric ulcer is more common in women. Although Moynihan,[1] in 164 gastric cases, had an equal distribution between the sexes, Balfour, in 1927, on the basis of the Mayo statistics stated

that the sex incidence for the chronic cases was the same as for duodenal ulcer, about 4 to 1 in favor of males. Sturtevant and Shapiro in their autopsied cases found the ratio of men to women about 3 to 1 in each group. While the difficulty in diagnosis renders a decision as to sex distribution in the simple acute erosions or ulcers uncertain, the recent literature and our results suggest that of those coming to operation and seen at autopsy the great majority, both gastric and duodenal, is in the male sex.

Age Incidence. The age incidence for each ulcer group is presented in Tables II to V, which show, for the total series of 279 cases, not only the age at which they were referred to the hospital for study and treatment, but also that at which according to their histories ulcer symptoms first occurred. The actual figures and the percentages are given for the sexes separately and combined.

Table II.—Age Incidence in 58 Gastric Ulcer Cases at the Time of Admission to Hospital, by Sex and for the Total Group

	Male.		Female.		Total group.	
Decade.	No.	Per cent.	No.	Per cent.	No.	Per cent.
10 to 19	1	2	..	..	1	2
20 to 29	5	10	..	..	5	8
30 to 39	8	15	..	..	8	14
40 to 49	21	40	4	66	25	43
50 to 59	10	19	1	17	11	19
60 to 69	7	14	1	17	8	14
Total	52	100	6	100	58	100

Table III.—Age Incidence in 221 Duodenal Ulcer Cases at the Time of Admission to Hospital, by Sex and for the Total Group

	Male.		Female.		Total group.	
Decade.	No.	Per cent.	No.	Per cent.	No.	Per cent.
10 to 19	1	0.5	..	..	1	0.5
20 to 29	31	16.5	2	6	33	14.9
30 to 39	60	31.8	10	30	70	31.7
40 to 49	57	30.4	9	28	66	29.8
50 to 59	30	16.0	11	33	41	18.5
60 to 69	8	4.3	..	..	8	3.6
70 to 79	1	0.5	1	3	2	1.0
Total	188	100.0	33	100	221	100.0

Three-fourths of the gastric cases (76 per cent) (Table II) were forty or more years of age at the time of admission, the majority of these (57 per cent or 43 per cent of the total number) being in the fifth decade of life; whereas only a half (52.9 per cent) of the duodenal cases (Table III) were aged forty years or over, and the numbers in

the fourth and fifth decades were approximately the same (31.7 and 29.8 per cent). Furthermore, three-fourths of the gastric cases (Table IV) had their first digestive symptoms after the thirtieth year and more than 60 per cent of the duodenal cases (Table V). (See Chart I.)

TABLE IV.—AGE INCIDENCE IN 58 GASTRIC ULCER CASES AT THE TIME OF ONSET OF SYMPTOMS, BY SEX AND FOR THE TOTAL GROUP

	Male.		Female.		Total group.	
Decade.	No.	Per cent.	No.	Per cent.	No.	Per cent.
10 to 19	2	4	1	17	3	5
20 to 29	11	21	..	..	11	19
30 to 39	13	25	1	17	14	24
40 to 49	13	25	3	49	16	28
50 to 59	9	17	1	17	10	17
60 to 69	4	8	..	..	4	7
Total	52	100	6	100	58	100

TABLE V.—AGE INCIDENCE IN 221 DUODENAL ULCER CASES AT THE TIME OF ONSET OF SYMPTOMS, BY SEX AND FOR THE TOTAL GROUP

	Male.		Female.		Total group.	
Decade.	No.	Per cent.	No.	Per cent.	No.	Per cent.
10 to 19	12	6.4	2	6	14	6.3
20 to 29	66	35.1	6	18	72	32.6
30 to 39	58	30.8	11	34	69	31.2
40 to 49	31	16.5	10	30	41	18.5
50 to 59	11	5.9	3	9	14	6.3
60 to 69	6	3.2	1	3	7	3.2
?	4	..	..	..	4	1.9
Total	188	100.0	33	100	221	100.0

Considering next the age distribution according to sex it will be observed, for both the gastric and the duodenal groups, that the men were younger both for the time of hospitalization and for the onset of symptoms. For the admission time, all the women with gastric lesions and 64 per cent of those with duodenal lesions were forty or more years of age against respectively 73 per cent of the men with gastric lesions and 51.2 per cent of those with duodenal lesions. For the time of onset of symptoms, the corresponding figures for the women were 66 per cent gastric and 42 per cent duodenal against 50 and 26 per cent respectively for the men. (See Chart II.)

These results find surprisingly little support in even recent textbooks, chiefly because it is still common practice to quote and be guided by statistics compiled years ago on the basis of autopsy findings and of unproved clinical diagnoses. C. F. Martin in

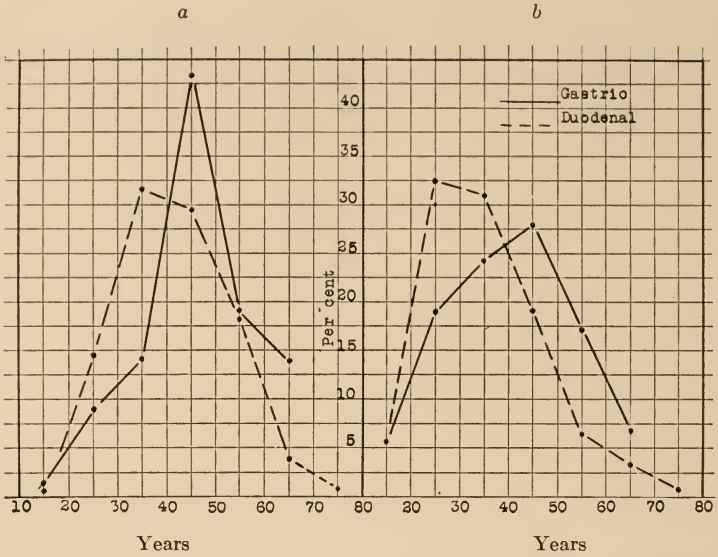

CHART I.—(*a*) Age of gastric and duodenal ulcer cases at time of admission to hospital (58 and 221 cases respectively). (*b*) Age at onset of symptoms in same cases of gastric and duodenal ulcer.

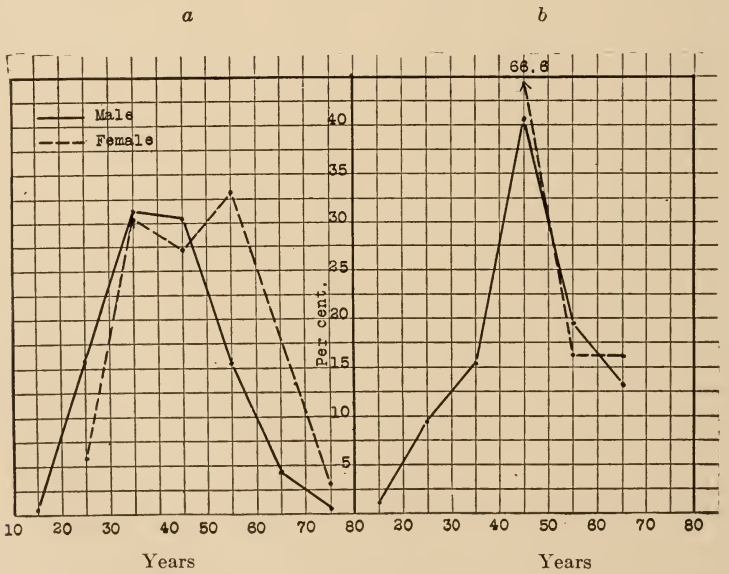

CHART II.—(*a*) Age of male and female duodenal ulcer cases at the time of admission to the hospital (188 and 33 cases respectively). (*b*) Age of male and female gastric ulcer cases at the time of admission to the hospital (52 and 6 cases respectively).

Osler's System[4] says that gastric ulcer is most common between twenty and thirty years of age and that the average age for males is 36.7 years and for females 27.1 years. His combined statistics on 704 cases showed 37 per cent in the third decade and 26.5 per cent in the fourth. Speaking specifically of duodenal ulcers he says that they are commonest in the third decade. Aaron,[5] in 1927, speaking of both gastric and duodenal cases, says that in women the period of liability was noted to begin earlier than in men and to reach its maximum at twenty-five to thirty years. Crohn,[6] in the same year, while admitting that ulcer more commonly becomes a clinical problem in the later decades states that its onset can be traced in over half the cases to the period between ten and thirty years of age and that gastric ulcer is more common in younger persons and duodenal ulcer of greater frequency in older individuals. In so doing he overlooks Gruber's statistics, which he himself quotes, showing 60 per cent of gastric ulcers to occur between forty and seventy years of age. He also gives Fenwick's statement of 1900 to the effect that three-fourths of the cases in females begin before the thirtieth year. Friedenwald,[7] in 1912, in an analysis of 1000 gastric and duodenal cases found the acme of incidence in the third decade, but his cases were not proved. On the other hand, Moynihan,[8] in the same year, analyzing 187 proved duodenal cases found the majority of them in the fourth and fifth decades, and Blackford and Dwyer,[9] in a recent paper covering 332 cases, found the average age at the time of diagnosis to be forty-one years for duodenal ulcer and forty-eight for gastric ulcer; they found 66 per cent of the former group seeking relief before forty-five years of age and only 33 per cent of the latter.

Symptoms. *Pain.* The outstanding and almost universal symptom of peptic ulcer is upper abdominal pain and in Table VI are given the terms used by our patients to describe the nature of the pain from which they suffered. Not infrequently several adjectives were employed in a single case: each has been recorded, and the totals for the vertical columns are, therefore, greater than the number of cases studied. It is interesting to note that, with the exceptions of "burning" and "gnawing," the adjectives occurred with almost equal frequency in the two groups. These exceptions, however, would seem to be of significance, since the term "burning" appears five times more often in the gastric series and "gnawing" only in the duodenal group. If burning pain indicates, as Hurst

has claimed, acid regurgitation into the esophagus, our findings would suggest that this happens much more often in cases of gastric ulcer. Gnawing pain is often attributed to overactive gastric peristalsis and yet only 5 of our 18 duodenal ulcer cases with this type of distress had hyperperistalsis on fluoroscopic examination, and only 8 had a residue of the barium meal after six hours; high acidity of the gastric contents was the condition most frequently associated (14 of the 18 cases). Severe pain occurred in almost one-third of each group and was associated with high gastric acidity in three-fourths of the cases; and with pyloric stenosis and adhesions, each, in one-half.

TABLE VI.—NATURE OF THE PAIN IN ULCER CASES

Descriptive term used by patient.	Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Severe	11	31	28
Dull	7	19	28
Sharp	9	25	18
Gnawing	..	..	18
Burning	14	39	8
Cutting	..	..	5
Boring	..	..	4
Aching	1	3	5
Colicky	..	..	4
Sense of fullness	1	3	3

TABLE VII.—LOCATION OF PAIN IN ULCER CASES

Location.	Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Epigastrium	28	78	92
Back	7	19	15
Right hypochondrium	4	11	2
Left hypochondrium	3	8	7
Lower abdomen	1	3	3
Left chest	2	6	
Shoulder	..	..	2

The location of the pain (Table VII) was usually, as is generally recognized, in the epigastric region (78 per cent for the gastric series and 92 for the duodenal). Of the 7 gastric ulcer cases having pain in the back, usually associated with epigastric pain, 4 had deeply penetrating lesions, 2 involving the lesser curvature and the other 2 the posterior wall of the stomach near the lesser curvature. Two others had indurated posterior wall ulcers, but the seventh was a gastroduodenal ulcer case without, so far as the records indicate, any involvement of the posterior wall. Of the 15 duodenal cases

with back pain 1 had an adhesion of the ulcer area to the pancreas, 2 had adhesions to the posterior wall of the abdomen, 2 others had gastric adhesions, a sixth one presented fibrous connection with the gall bladder, and a seventh and an eighth, adhesions about the appendix and duodenum, respectively: others, though specific adhesions were not mentioned, had old indurated ulcers that had existed for from two to ten years. It is quite probable that some of these also had posterior connections. One other case with back pain should be referred to as it was our only instance of ulcer in the second part of the duodenum; another was at the junction of the first and second parts. It would appear, therefore, that when an ulcer patient complains of referred pain in the back the probabilities are that the ulcer is an old one and that there exist adhesions to structures posterior to the stomach. The occasional complaint of right or left upper quadrant pain did not seem to have significance, though of the 2 gastric cases having left chest pain the lesions were high on the lesser curvature and 1 was of the deeply penetrating type.

TABLE VIII.—TIME OF PAIN IN ULCER CASES

Time in relation to meals.	Gastric ulcer. No.	Gastric ulcer. Per cent.	Duodenal ulcer. No. and per cent.
Immediately after	5	14	2
Within one-half hour after	1	3	1
One-half to one hour after	3	8	8
One to two hours after	9	25	12
Two to three hours after	1	3	29
Three to four hours after	2	6	15
No relation	11	30	13
Not stated	4	11	30
Total	36	100	100

Table VIII shows that in most instances a fixed time relation of the pain to meals existed, but that the interval between the ingestion of food and the onset of the pain varied considerably. In a large way it may be pointed out that the gastric lesions tended to give a shorter interval than the duodenal ones (the largest percentage of those in which a relationship existed having a period of one or two hours against a period of two or three hours for the duodenal cases). It has been stated that the higher the lesion in the stomach the sooner the pain after food, but our data do not lend support to this idea and, furthermore, it is difficult to explain the time variation in the

duodenal cases on such a basis. Of those having no food-pain relationship the majority was gastric: this cannot be explained on the basis of gastric retention since a gastric residue six hours after a barium meal occurred with about equal frequency in the two groups.

Various factors give temporary relief from the pain caused by these ulcers, but the ingestion of food was the most frequent factor in our series (36 per cent for the gastric group and 57 per cent for the duodenal group), as showed in Table IX. The administration of alkalies was next most effective in each group. This relief undoubtedly comes as a result of neutralizing the acid gastric contents, but whether such neutralization acts by lessening direct chemical irritation of the ulcer area or by decreasing peristalsis and local spasm is not settled. This is a problem which we plan to investigate by means of simultaneous fluoroscopic observation and chemical studies on gastric and duodenal contents. Vomiting also probably acts as a means of relieving pain by ridding the stomach of the stimulating material.

Table IX.—Factors Producing Relief of Pain in Ulcer Cases

Factor.	Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Ingestion of food	13	36	57
Administration of alkalies	8	22	44
Vomiting	9	25	23
Pressure	1	3	2
Eructations	3	8	
Catharsis	1	3	2

Table X.—Frequency of Phenomena Other than Pain in Ulcer Cases

Phenomenon.	Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Vomiting	27	75	68
Eructations	21	58	64
Nausea	12	33	35
Hematemesis	15	42	19
Appetite:			
Good	10	28	29
Poor	13	36	11
Not stated	13	36	60
Bowels:			
Constipated	17	47	56
Diarrhea	1	3	6
Normal	10	28	20
Not stated	8	22	18
Periodicity of symptoms	22	61	64

Other Symptomatic Phenomena. All of the phenomena referred to in Table X have some bearing on diagnosis when considered in connection with characteristic pain and other special diagnostic findings, but, with the exception of hematemesis, have far less significance than has pain itself. Vomiting, eructations and nausea are present in so many gastric and even extragastric conditions that their presence alone or combined means little or nothing. Fortunately they occur rarely in ulcer cases without associated pain. Macroscopic blood in the vomitus is of great importance and should always suggest the possibility of ulcer even when there are no other symptoms. It will be noted that 42 per cent of the gastric cases and 19 per cent of the duodenal ones showed it; this figure for the gastric series would probably be lower in a larger series, since in the Mayo cases for 1921 and 1922 (1072 cases) only about one-fifth of each group showed gross hemorrhage. The appetite was more often impaired in the gastric than in the duodenal cases, for which we have no explanation since retention occurred with equal frequency in the two groups. Our figures support the general opinion that ulcer patients are frequently constipated, but the percentages are not greater perhaps than for hospital cases as a whole. Periodicity of symptoms is of considerable diagnostic importance. By this term is meant the presence of characteristic symptoms over periods of months with intervening periods of months or even years in which no such symptoms are manifest. It will be noted that it occurred in each group, and with about the same degree of frequency.

Table XI.—Number and Percentage of Ulcer Cases that Perforated, by Decades and for the Two Groups

	Gastric cases.			Duodenal cases.		
Decade.	Total No.	No. perforating.	Per cent perforating.	Total No.	No. perforating.	Per cent perforating.
10 to 19 . .	1	1	100	1	1	100
20 to 29 . .	5	3	60	33	5	15
30 to 39 . .	8	2	25	70	8	16
40 to 49 . .	25	3	12	66	7	11
50 to 59 . .	11	2	18	41	6	15
60 to 69 . .	8	0	0	8	4	50
70 to 79 . .	. .	. .	. .	2	0	0
Total . .	58	11	19	221	31	14

Incidence of Perforation. Perforation occurred in 42 of our series of 279 cases (15 per cent): 11 of the gastric group (19 per cent) and 31 of the duodenal (14 per cent) (Table XI). No special decade

of life showed a preponderance of these: 19, 24, 24 and 19 per cent occurring respectively in the third, fourth, fifth and sixth ten-year periods. These figures are in agreement with those of Dunbar[10] who, in a large series of 387 perforating cases, found 21.9, 29.2, 20.6 and 17.2 per cent in the same respective decades. Of the ulcer cases occurring in each decade, the percentage that perforated is shown in the table. It will be noted that each of the 2 cases under twenty years of age perforated, that the next highest percentage for the gastric cases was in the third decade, that the frequency of perforation for the duodenal cases for the third, fourth, fifth and sixth decades was about the same, and that 4 of the 10 cases in the seventh and eighth decades (40 per cent) perforated. Table XII shows that in 2 of our gastric cases and in 5 of the duodenal ones perforation occurred without a preceding history of digestive trouble, but all the others gave such a history, though symptoms had been present in most of the gastric cases less than a year.

Table XII.—Duration of Digestive Symptoms in Ulcer Cases that Perforated (in Total Series of 279 Cases)

Time.	Gastric. No.	Duodenal. No.
None before perforation	2	5
One month or less	2	7
Two to eleven months	4	1
One to two years	..	5
Three to four years	..	6
Five to nine years	..	5
Ten years or more	3	2
Total	11	31

Table XIII.—Duration of Symptoms Before Admission to Hospital in 279 Ulcer Cases

Time.	Gastric.		Duodenal.	
	No.	Per cent.	No.	Per cent.
None before perforation	2	3	5	2
One month or less	5	9	14	6
Two to eleven months	8	14	19	9
One to two years	13	22	36	16
Three to four years	5	9	32	15
Five to nine years	12	21	53	24
Ten to fourteen years	6	10	27	12
Fifteen or more years	6	10	31	14
Not stated	1	2	4	2
Total	58	100	221	100

Duration of Symptoms. The duration of symptoms in the total series of 279 ulcer cases (Table XIII) is similar for the two groups,

and the variation in the time is striking. The ones showing no preceding digestive symptoms were admitted because of perforation. Approximately a fourth of the gastric and a sixth of the duodenal cases had been troubled for less than a year. More than 10 per cent of each group had had symptoms for fifteen or more years and a few stated that they had always had spells of indigestion.

TABLE XIV.—PHYSICAL FINDINGS IN ULCER CASES

Positive finding.	Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Spot of tenderness	21	57	38
Muscular rigidity	5	14	7
Palpable mass	3	8	4
Visible peristalsis	2	6	5
Oral sepsis	21	57	?

PHYSICAL EXAMINATION. Although Moynihan states that an accurate diagnosis of peptic ulcer may be made without a physical examination, Table XIV shows that 57 per cent of our gastric and 38 per cent of our duodenal cases had a definite spot of epigastric tenderness. Such a finding, together with a suggestive history, is frequently of diagnostic aid, but it may occur in the absence of ulcer. When, in addition, there is muscular rigidity or a palpable mass or visible gastric peristalsis the physical examination becomes of great importance. In 1 of our cases with a palpable mass an old duodenal ulcer with calcified glands about it was found; another had an old healed ulcer with adhesions producing a diverticulum of the duodenum; others with a mass had no unusual findings at operation but roentgen-ray study showed pylorospasm and this doubtless produced the mass that was felt. Two of the gastric cases with muscular rigidity had deeply penetrating ulcers. The cases with visible peristalsis, with a single exception, had pyloric stenosis or spasm with gastric retention.

TABLE XV.—GASTRIC RETENTION IN ULCER CASES (THOSE HAVING SIMPLE TEST-MEAL).

Amount of contents 45 to 60 minutes after test-meal.	Gastric ulcer (16 cases). No.	Gastric ulcer (16 cases). Per cent.	Duodenal ulcer (47 cases). No.	Duodenal ulcer (47 cases). Per cent.
Less than 100 cc.	6	38	13	28
100 to 200 "	5	32	19	40
200 to 300 "	2	12	7	15
300 to 400 "	1	6	4	9
400 to 500 "	1	6	2	4
500 to 600 "	1	6	2	4
Total	16	100	47	100

Gastric Analysis. During recent years our patients have been given fractional test meals routinely and in consequence only the earlier ones, whose total gastric contents were removed forty-five minutes to one hour after ingestion of the Ewald meal, could be used in the preparation of Table XV. The amounts obtained at that time have been grouped; and, if we consider, as is usually done, a quantity over 100 cc. as indicative of gastric retention, it will be observed that 62 per cent of the gastric cases showed retention and 72 per cent of the duodenal ones. An almost equal percentage showed, by fluoroscopic examination, a moderate to marked residue of the barium meal after six hours. It is our belief that such a simple total removal of the gastric contents forty-five minutes to one hour after the administration of an Ewald meal is as satisfactory a method of showing the degree, if any, of gastric retention as is the usual roentgenologic study.

Table XVI gives the maximal free hydrochloric acid concentration and total acidity of the gastric contents after Ewald meals in 30 of the gastric and 83 of the duodenal cases. In the others it had not been considered safe to introduce a gastric tube. Forty-six per cent of the gastric cases had free hydrochloric acid figures (20 to 39) that are within so-called normal limits, whereas 41 per cent had what has by some been considered hyperchlorhydria. Only 1 case had no free hydrochloric acid. All the duodenal cases had some free acid, but in 7 per cent it was below normal; on the average the acidity in these cases was higher than for the gastric group. Rehfuss[12] found the total acidity in excess of 70 in 38 per cent of his series of gastric ulcer cases, but he also found that 40 to 45 per cent of supposedly normal individuals had a concentration higher than that. Bennett and Ryle[13] in a series of 100 healthy men found some free acid concentrations as high as 100 and concluded that a high acid figure cannot in itself be regarded as a pathologic finding. Bell[14] in 24 gastric ulcer cases found the acidity low in 33 per cent, intermediate in 21 and high in 46; in 34 duodenal ulcers he found the respective percentages to be 12, 9 and 79. Moynihan[1] in 39 gastric ulcer cases found intermediate acidity in 34.2 per cent and high acidity in only 20.9 per cent; whereas in 71 duodenal cases he found 72.7 per cent to have high acidity. Rehfuss in 100 cases of duodenal ulcer got a high acid curve in 78 per cent and Ryle[15] quotes figures which show 70 per cent of chronic duodenal ulcers with high acidity and 30 per cent with intermediate acidity; none with low acidity and achlor-

hydria. Our data, together with those quoted, would seem to indicate a tendency toward high acidity in both gastric and duodenal ulcer, greater in the latter, and yet gastric ulcer may occur with no free hydrochloric acid and duodenal ulcer only rarely, if ever, has an acid concentration greater than may be found in certain presumably healthy persons.

TABLE XVI.—FREE HYDROCHLORIC ACID CONCENTRATION AND TOTAL ACIDITY OF GASTRIC CONTENTS IN ULCER CASES (HIGHEST FIGURES WHEN FRACTIONALS DONE)

Amount required to neutralize 100 cc. N/10 NaOH.	Gastric ulcer (30 cases).				Duodenal ulcer (83 cases).			
	Free HCl.		Total acidity.		Free HCl.		Total acidity.	
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
0	1	3						
10 to 19 cc.	3	10	1	3	6	7		
20 to 29 cc.	7	23	..	...	7	8	1	1
30 to 39 cc.	7	23	1	3	13	16	6	7
40 to 49 cc.	8	27	5	17	14	17	4	5
50 to 59 cc.	1	3	6	21	17	21	6	7
60 to 69 cc.	2	7	7	23	6	7	15	18
70 to 79 cc.	..	...	7	23	12	14	14	17
80 to 89 cc.	1	4	1	4	5	6	8	10
90 to 99 cc.	..	...	2	7	3	4	12	15
100 to 109 cc.	..	...	..	...	..	...	6	7
110 to 119 cc.	..	...	..	...	..	...	6	7
120 to 129 cc.	..	...	..	...	..	...	2	3
150 to 159 cc.	..	...	..	...	..	...	3	3
Total	30	100	30	100	83	100	83	100

ROENTGENOLOGIC CONSIDERATIONS

By EUGENE P. PENDERGRASS, M.D.

TABLE XVII gives the roentgenologic findings under six headings. The type of stomach has been divided roughly into three classes, the grouping being made with regard to the position of the stomach rather than the tone. A level corresponding to the upper limits of the crest of the ilia has been used arbitrarily as the dividing line.

Any stomach that had the greater curvature on the level with the crests of the ilia was regarded as the fish-hook type, above steer horn, and below ptotic, the films being made in the erect posture.

TABLE XVII.—ROENTGENOLOGIC FINDINGS IN ULCER CASES

Roentgenological finding.		Gastric ulcer (36 cases). No.	Gastric ulcer (36 cases). Per cent.	Duodenal ulcer (100 cases). No. and per cent.
Anatomic type of stomach	Fish-hook	15	42	64
	Steer-horn	6	17	14
	Ptotic	13	36	19
	Not stated	2	5	3
Residue of barium meal in stomach after six hours	Slight	3	8	21
	Moderate	6	17	19
	Marked	13	36	17
	Complete	4	11	3
	None	9	25	36
	Not stated	1	3	4
Type of gastric peristalsis	Hyperperistalsis	21	59	65
	Hypoperistalsis	8	22	15
	Normal	5	14	15
	Not stated	2	5	3
Degree of gastric motility	Hypermotility	20	55	51
	Hypomotility	14	39	26
	None	..	..	5
	Normal	1	3	15
	Not stated	1	3	3
Pyloric spasm	Present	17	48	30
	Absent	8	22	53
	Uncertain	3	8	6
	Not stated	8	22	11
Constant defect in films .	Present	31	86	92
	Absent	5	14	6
	Not stated	..	..	2

The table shows that both the gastric and the duodenal ulcers occurred most frequently in the fish-hook, or prevailing type of stomach, the second in frequency being in the ptotic variety. This data is probably of no significance except in correcting an impression of ours, that the ulcers would probably be found most frequently in the ptotic variety of stomach because of the mechanical factor of decreased motility with subsequent decreased tonicity. The position of the stomach is probably of no significance, therefore, if one is justified in drawing conclusions on such a small series of cases.

The amount of residue as indicated in the table is self-explanatory. It will be noted that a residue occurred in 26 (72 per cent) of the gastric cases and 60 (60 per cent) of the duodenal group. The causes of residue in the gastric cases were as follows: 15 gave evidence of pylorospasm, 4 had organic obstruction, and in 7 we found no specific explanation.

Of the duodenal cases (60) showing retention after six hours, 23 showed pylorospasm and 20 organic obstruction; no explanation can be given for the residue in the other 17 cases. Our finding of

60 per cent with gastric residue is greatly in excess of that reported by Carman[16] who in larger series of 417 duodenal ulcer cases observed that a residue occurred in 25 per cent. If, however, the 11 cases of pyloric stenosis and the 9 cases of gastroduodenal ulcer are excluded, the percentage showing retention is reduced to 40, and this approximates the figures given by other observers.

The type of gastric peristalsis, whether normal, excessive or subnormal, has been based on the activity of the stomach as disclosed after a ten- to fifteen-minute fluoroscopic examination. No attempt is made to further subdivide these groups, although every roentgenologist recognizes at least various subtypes of hyperperistalsis and we have observed them. Fifty-nine per cent of the gastric and 65 per cent of the duodenal cases showed some form of excessive peristalsis. In the group of gastric ulcers, the waves were either interrupted at the site of the ulcer or they began below it. Continuous waves of hyperperistalsis were more often noted in the gastric group and paroxysmal waves of hyperperistalsis with intermittent periods of inactivity were more frequently observed in the duodenal ulcer series. Antiperistalsis was noted in a few cases of extreme pylorospasm and stenosis. Hypoperistalsis was noted in stomachs that had very little tone in both groups; in the duodenal group it occurred more often in the lesions with which there was an associated marked residue. Not infrequently these lesions had been present for a long time, possibly accounting, therefore, for the lack of tone.

By gastric motility is meant the passage of stomach contents into the duodenum and the term has no reference to peristaltic activity. Hypermotility was observed in 20 (55 per cent) gastric, and 51 (51 per cent) duodenal cases. The former figure is surprising since it is generally assumed that hypermotility does not occur in the presence of pylorospasm. In our gastric cases 48 per cent had pylorospasm, as against 30 per cent in the duodenal group. More careful analysis reveals, however, that of the 20 gastric cases 6 had definite pyloric spasm at some time during the fluoroscopic examination. It must be admitted, therefore, that hypermotility, as we interpret it, can occur when spasm of the pylorus is present. In the 6 cases with pylorospasm and hypermotility 4 ulcers were located on the lesser curvature and 1 was on the greater curvature, but 1 was a small ulcer near the pylorus. The relatively low percentage (51) of hypermotility in the duodenal group is to be explained by the fact that we included 20 cases with organic pyloric obstruction. Exclu-

sive of these and of those in which no statement of motility is made, hypermotility occurred in 66 per cent and normal motility in 20 per cent. In the 14 gastric cases having hypomotility, 10 had pyloric spasm, 3 had organic stenosis at operation and the other a large sclerosing ulcer near the cardia.

Pyloric spasm, presumably a reflex phenomenon from gastric ulceration, was present in only 17 (48 per cent) of our gastric cases.

This figure is less than anticipated, and occurred most often when the lesion was near the pylorus (13 of the 17 cases); in 3 cases the ulcer was on the lesser curvature and in 1 on the greater. When definitely stated that no spasm was present, the lesion was high on the lesser curvature except in two instances in which the gastric ulcer reached the pyloric ring (gastroduodenal ulcers). If the cases in which no statement of spasm was made, and in which it was uncertain, are excluded, pylorospasm occurred in 68 per cent of the gastric series. Calculating in the same way 36 per cent of the duodenal cases showed pylorospasm and in these the ulcer was found just distal to or at least very near the pyloric ring.

A great deal of diagnostic importance has been placed on the presence or absence of a constant filling defect in the films of the above series of cases. Only 11 cases, 5 gastric (14 per cent) and 6 (6 per cent) duodenal out of the entire series failed to show such a defect. Pancoast[17] has always laid a great deal of stress upon a routine which consists of a fluoroscopic and a roentgenographic study. For instance, a deformity of the stomach or duodenum appearing in the films may be due to a number of lesions, and without a fluoroscopic examination one hesitates to make a differential diagnosis. Likewise, fairly typical fluoroscopic phenomena cannot be regarded as entirely diagnostic without a filling defect. It is true that one not infrequently ventures the opinion of a nondeforming ulcer, yet such a diagnosis cannot be accepted as readily as if there were a small defect present. The filling defect itself may be and usually is due to a small lesion plus spasm or adhesions, except when there is definite cicatrization present.

The roentgenologic diagnoses and the operative findings in the 36 gastric ulcer cases are presented in Table XVIII. It is felt that with the exception of the 2, in which the stomach was said to be negative, these diagnoses may be accepted as correct (94 per cent). Both of the errors occurred in the patients who had very small ulcers on the lesser curvature and in 1 of these, because of extreme anemia

following a gastric hemorrhage, the examination had not been complete. It is at times impossible for the roentgenologist to state with certainty whether a gastris deformity is due to ulcer or adhesions, but usually his demonstration of the filling defect alone is sufficient, when the clinical history is taken into consideration, to establish the exact diagnosis. This is our justification for including as correct the 4 cases reported as ulcer or adhesions. The definite determination of pyloric stenosis is considered a diagnosis in itself, justifying operation no matter what its cause, and the roentgenologist cannot be expected, in the usual case, to go further.

TABLE XVIII.—ROENTGENOLOGIC DIAGNOSIS IN 36 PROVED GASTRIC ULCER CASES

Diagnosis.	No.	Operative findings.
Ulcer of the lesser curvature	19	Seventeen on lesser curvature, 2 on posterior wall near pylorus.
Gastric ulcer, location not stated	4	One on posterior wall, 1 on lesser curvature, 1 on greater curvature, location of other not stated.
Gastric ulcer or adhesions	4	One on lesser curvature, 1 near pylorus, location of others not stated.
Pyloric obstruction	3	All showed stenosis associated with gastric ulcer.
Gastric ulcer or subtotal gastrectomy.	1	Large ulcer on lesser curvature near pylorus with adhesions.
Gastric ulcer, probably on posterior wall	1	On posterior wall near greater curvature.
Gastric ulcer at pylorus with crater	1	Confirmed.
Gastric ulcer or carcinoma	1	On lesser curvature.
Stomach negative	2	Both showed ulcer on lesser curvature, 1 being very small.

Diagnosis correct in 94 per cent of cases.

TABLE XIX.—ROENTGENOLOGIC DIAGNOSIS IN 100 PROVED DUODENAL ULCER CASES

Diagnosis.	Number and per cent.	Special operative findings.
Duodenal ulcer	15	Confirmed.
Duodenal ulcer probably	13	All ulcers.
Duodenal ulcer or adhesions	20	All ulcers.
Duodenal ulcer and adhesions	7	Confirmed.
Duodenal adhesions	3	One healed, 1 very small ulcer, 1 ulcer and adhesions.
Duodenal adhesions probably	6	Three healed, 1 at junction first and second portions, 1 small on anterior wall, 1 large on posterior wall.
Duodenum uncertain because it was not shown on films	2	One large stellate, first portion; 1 small, indurated, near pylorus.
Duodenum negative	1	Ulcer of second part of duodenum.
Pyloric ulcer	4	Two were pyloric; 2 duodenal.
Pyloric stenosis	11	Two ulcers at pylorus, 9 beyond it.
Gastroduodenal ulcer	9	One was typically pyloric; 8 on duodenal side.
Total	100	
Diagnosis practically correct	88	
Diagnosis missed	12	

In the duodenal group analyzed in Table XIX there are several diagnoses that should be discussed. Three cases were diagnosed duodenal adhesions and 6 probable duodenal adhesions. In these 9 cases, the films showed an inconstant filling defect, and there was an absence of fluoroscopic phenomena that would suggest an ulcer. It is rather interesting to note that 4 of these cases had healed ulcers. Possibly one should make a diagnosis of ulcer or adhesions with the majority of evidence in favor of one or the other. This seems logical when we appreciate that the major portion of a given filling defect may be spasm or spasm plus adhesions.

In the group "duodenum uncertain because it was not shown on films" the fluoroscopic phenomena were not typical and the examination should have been repeated, but the clinical phenomena were suggestive enough to justify operation without additional confirmatory evidence.

Table XX.—More Complete Roentgenologic Diagnosis and Operative Findings in 11 Proved Duodenal Ulcer Cases Listed under Heading of Pyloric Stenosis in Table

No. of case.	Roentgenologic diagnosis.	Operative findings.
19	Pyloric stenosis, with eighteen-hour retention. No filling of duodenal cap.	Old crater-like ulcer with annular contraction 1 inch beyond pylorus.
33	Pyloric obstruction. Ulcer or secondary carcinoma of stomach (?)	Large callous ulcer 1 inch beyond pylorus.
41	Pyloric stenosis due to ulcer or carcinoma.	Duodenal ulcer producing complete obstruction.
63	Pyloric obstruction with spasm. Duodenum uncertain due to lack of filling.	Ulcer of first part of duodenum with adhesions.
66	Pyloric obstruction with dilatation; cause uncertain; forty-eight-hour retention.	Dilated and atonic stomach. Ulcer on anterior wall of duodenum near pylorus.
70	Pyloric obstruction with gastric dilatation. Duodenum probably negative.	Ulcer of first part of duodenum.
75	Pyloric obstruction with spasm. No visible ulcer. Duodenum uncertain due to lack of filling.	Small ulcer at pylorus.
96	Pyloric obstruction.	Large indurated ulcer ½ inch beyond pylorus.
106	Pyloric obstruction: carcinoma, ulcer or adhesions.	Old indurated ulcer of duodenum.
125	Pyloric stenosis. No filling defect due to stenosis.	Callous duodenal ulcer.
143	Pyloric stenosis. Pyloric ulcer. Duodenum uncertain.	Ulcer of pylorus.

One case was diagnosed "duodenum negative," and at operation an ulcer was found in the second portion of the duodenum. For-

tunately, ulcers occur in the second portion very rarely,[16] and when they do one can occasionally make the diagnosis by the fluoroscopic phenomena. Direct evidence of the ulcer cannot be obtained in the second portion because of the rapid motility. The duodenal bulb is the only part in which there is a normal stasis.[16]

The diagnosis of "pyloric stenosis and gastroduodenal ulcer" was made on 20 occasions in this group and of these 17 cases had the pathology on the duodenal side. The gastroduodenal ulcer is possibly an earlier stage of pyloric stenosis when one gets enough filling of the duodenal bulb to show the defect and its extension to the pylorus. This ulcer may ultimately cause obstruction from either cicatrization, spasm, or both. Pyloric obstruction is essentially an entity and will always remain so and the patient is operated upon to relieve the obstruction.

To summarize the findings in Table XIX one will note that the diagnosis was essentially correct in 88 instances, and missed in 12. Of the 12 cases, 4 had healed ulcers, 2 definitely active ulcers and 2 in which the duodenum was not shown, and finally there was 1 case in which there was no filling defect in the duodenal bulb but an ulcer was found in the second portion.

Table XX referring to the 11 pyloric stenosis cases does not need any further comment.

Summary and Conclusions. The clinical and laboratory data on 279 operatively proved gastric and duodenal ulcer cases, representing a ten-years' experience in this hospital, are analyzed, especial attention being given to a selected group of 36 gastric and 100 duodenal cases. The duodenal outnumbered the gastric cases in the ratio of 4 to 1, and it is pointed out that for all of those presenting symptoms the duodenal preponderance is even greater. The male sex predominated in each group (85 to 90 per cent) and the women were on the average a little older than the men. Aside from the roentgenologic findings, the history was of greatest diagnostic importance and sometimes afforded evidence suggesting the gastric or duodenal localization of the lesion. The physical examination was of less diagnostic importance, although the finding of a small spot of epigastric tenderness occurred in almost one-half of the cases and was regarded as of confirmatory value. Both groups of cases showed a tendency to high gastric acidity, more marked in the duodenal, but it is emphasized that such high acidity may occur in individuals

free of all evidence of disease and so in itself cannot be accepted as evidence of ulcer.

The roentgenologic findings may be summarized as follows:

1. The roentgenologic diagnosis was correct in 94 per cent of the gastric and 88 per cent of the duodenal ulcers.

2. The most important roentgenologic diagnostic sign was the filling defect.

3. In 23 cases that were diagnosed either pyloric stenosis, gastroduodenal ulcer or pyloric obstruction only 6 ulcers seemed to be pyloric in origin, the others being distinctly duodenal.

4. Healed ulcers give similar filling defects to adhesions or ulcer, but do not have associated suggestive fluoroscopic phenomena.

Note.—Our thanks are due Dr. G. P. Muller and Dr. E. L. Eliason, surgeons of the University Hospital, for their kindness in allowing us to secure the operative data reported in this paper from their records.

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DISCUSSION

Dr. Henry K. Pancoast: General statistics on medical subjects are too easily influenced to suit the occasion when made by one man from one point of view. When made by two individuals working together, but from two different viewpoints, they are much more likely to be reliable. The statistics reported in the presentation just given are of the latter type, and we can have confidence in them. We can be fairly well satisfied with a showing of 88 per cent practically correct roentgenological diagnoses in duodenal ulcer when based upon the factors of proof employed by Dr. Miller and Dr. Pendergrass. Some men, it is true, report higher figures. But bear in mind that these are not true statistics for all cases examined, because we have no proof of the accuracy of diagnosis in the large number of cases not operated upon.

Duodenal ulcer diagnosis cannot be infallible because there are definite sources of error. Ulcers of the second portion of the duodenum cannot be diagnosed except upon the basis of secondary evidence. Adhesions and congenital veils may closely simulate the defects of ulcer, and the secondary evidences may also be simulated in these conditions.

Clinical evidence is by no means definite or typical in all cases of duodenal ulcer, and the statistics show that the roentgenological evidence is not positive or correct in 12 per cent of cases. When both findings are correlated, the most accurate results will be obtained. As there must be a certain amount of disagreement, a very good working rule has been adopted in many clinics to the effect that: If the roentgenologic evidence is typical, the case is treated on the basis of an ulcer, whether the clinical evidence is strongly positive or not; if the clinical aspect is *typical* of ulcer, and the roentgenological findings uncertain or negative, the case is also to be treated on an ulcer basis.

We have used the term gastroduodenal ulcer to designate a lesion which has been primarily duodenal, but has invaded or even crossed the pylorus. It is a necessary roentgenological term, because, as the pylorus begins to be involved, the roentgen-ray signs become altered in a manner different from either strictly duodenal ulcer or gastric ulcer. The secondary evidences of gastric and of duodenal ulcer are almost diametrically opposite. In each there is a hypertonicity of the stomach action. In gastric ulcer this is exhibited in part as pyloric spasm if the lesion is near the pylorus. More distant ulcers do not do this, nor the old and large ulcers near the pylorus which are comparable to carcinomas in their cellular infiltration of the stomach walls. Direct pyloric involvement eventually leads to stenosis. In duodenal ulcer, on the other hand, there is a gastric hypertonicity exhibited as a hyperperistalsis, often of a characteristic type, and there is an associated commensurate hypermotility. Pyloric spasm is not present except sometimes in later extension to the pylorus. And yet many cases of duodenal ulcer show an unexplained six-hour residue.

We have been surprised and also interested in the group of cases diagnosed as pyloric stenosis to learn that a large proportion of them were found to

have duodenal ulcers. It was always our impression that most of them were gastric. Nevertheless, the roentgenological diagnosis of pyloric stenosis must stand as an entity. Furthermore, it makes no difference just where the ulcer is in such a case, for the treatment must be the same. The situation is analogous to that found by the Bone Tumor Registry. As long as the roentgen examination must be depended upon, roentgenological entities must be recognized.

Our negative ulcer diagnoses are frequently confronted by operative findings of healed ulcers. It is an unfortunate situation. Healed ulcer is a term of quite wide interpretation. Certainly small healed ulcers are likely to present no defects and give no secondary evidences, and if a small scar defect is present it may be easily mistaken for the result of an adhesion.

We are frequently called upon from time to time to examine cases which are being treated medically for duodenal ulcer, in order to determine improvement or retrogression. The information gained is often of doubtful value. Duodenal cap defects are due to ulcer craters, scar defects and spasm. The last factor is often the most potent one. Apparent improvements or retrogressions based upon the cap deformity may be erroneous impressions because the spasmodic element of the defect may vary at different times and the change not be indicative of the state of the ulcer.

Dr. George P. Muller: Mention has been made of the diagnosis of "healed ulcer." This might be considered in the same category as chronic appendicitis. Chronic appendicitis is healed appendicitis, and yet patients may have symptoms from the adherent or kinked appendix. Patients with deformity of the duodenum, and with definite symptoms referable to the stomach, may be just as much in need of treatment as those with an open shallow ulcer. They may not be in as much danger from hemorrhage, but interference with duodenal peristalsis may cause epigastric pain and distress. Regarding the pyloric ulcer, it is well to remember that the pylorus projects into the duodenum somewhat like the cervix into the vagina, and an ulcer high in the duodenum, in this fornix, may progress in a circular direction, causing a certain amount of interference with the pylorus, which thus constitutes a pyloric lesion. Lastly, the late age incidence shown for gastric ulcer, the uncertain findings by gastric analysis, the common symptom of epigastric pain common to carcinoma, make me wonder how it is possible to diagnose gastric carcinoma at a stage amenable to treatment. So it seems to me we must consider gastric ulcer as a more important indication for surgery than the duodenal, which may be given over to medical treatment for a considerable time without risking too much except comfort.

PRESENT TRENDS AND FUTURE POSSIBILITIES IN PREVENTIVE MEDICINE*

By ALLEN W. FREEMAN, M.D.
BALTIMORE, MD.

In the dim beginnings of Greek medicine, where fact and fancy were so indistinguishably mingled, Hygeia was worshipped as the daughter of Aesculapius. Through many long centuries the worship of Hygeia was neglected and forgotten, and it is only in our own time that Prevention has come again into her heritage and taken her proper place at the side of Cure.

This coming of age of Medicine's oldest child has not been without the disturbance and difficulty usual to such occasions. Medicine's other progeny, Dentistry and Pharmacy, have been docile, well-behaved children, easily kept in proper relation to their progenitor. Prevention, it would appear, is a wayward daughter, presumptuous, overzealous, critical of parental wisdom and behavior, and inclined to trespass on the rights and privileges that Cure has so long exclusively enjoyed.

It is inevitable, of course, that when two such close relatives are thrown into intimate and continuous contact there should be clashes of temperament and sometimes of temper as well. That such clashes are taking place is quite evident to anyone who attends medical or public health meetings or reads the periodicals of the two groups.

We find the medical man using such terms as "state medicine," "medical bureaucracy" and "pauperization of private patients." The sanitarians refer to "inadequacy of medical service," "indifference of private practitioners," "lack of coöperation," "opposition to public health measures" and such matters.

It is not our purpose to review the arguments of both sides, or of either side, in this engaging controversy, or to attempt a composition of the quarrel. Only time and the logic of circumstances may be expected to reconcile these present differences of opinion and of interest. It is your speaker's thought, however, that a physician

* Read May 2, 1928.

whose professional life has been spent in prevention, speaking to an audience largely made up of physicians whose professional lives have been spent in cure, might well use this opportunity to attempt to interpret to you not only the present activities, but some of the ideals, hopes and aspirations, of that large and growing group of physicians who worship at the altar of the daughter of Aesculapius.

It is not necessary to review in detail the steps in the progress of preventive medicine since industrialism and urbanization became the characteristic features of modern social organization. Those problems of sewerage, drainage, water supply, refuse disposal and housing which challenged the pioneers in sanitation, no longer confront us. Lemuel Shattuck and Stephen Smith in this country, and Edwin Chadwick and John Simon in England, defined the problem, and their coworkers and successors have carried the solution to an almost completely satisfactory conclusion. Colossal as was the task of cleaning the cities, it has been accomplished, and such sanitary activities now constitute only a very minor phase of the work of the modern health administrator here or in England.

The second phase in the development of preventive medicine, the attack on the acute communicable disease, which occupied so much of the thought and activity of health officials in the years just before and after the beginning of the twentieth century, has likewise come not to complete success, but in a very real sense to a stalemate. There is no great hope of further reducing the prevalence of communicable disease by methods designed to limit the spread of infectious agents through the population. The intestinal diseases yielded readily and almost completely to such measures. The respiratory diseases and those spread by the secretions of the upper air passages have, since the great decline in the mortality from diphtheria, scarlet fever and measles which took place during the last quarter of the nineteenth century, shown a decided disinclination to further reduction. Some, indeed, like influenza and poliomyelitis, have shown no reduction in prevalence or in virulence. Our present methods of attack, based on the effort to prevent spread of infection, are, under the conditions in the best organized of our large cities, about as extensive and as efficient as can be expected in our present social order. Further progress may be expected only from entirely different methods of attack, of which artificial immunization of the population to the degree necessary to prevent the propagation of the virus now holds out most hope of success. In

smallpox this has already been done in many foreign countries and in some of our own eastern cities and states. In diphtheria there is substantial ground for hope that artificial immunization may make possible the effective control of that disease.

With the turn of the century, the inauguration of the third and current phase of public health development was marked by the opening of the attack on tuberculosis. This endemic communicable disease, chronic in its course, almost universal in its prevalence and of first importance in its social destructiveness, is manifestly not subject to attack by those simple and direct measures applicable to the common acute communicable diseases.

In the early days of the campaign against tuberculosis, many experiments were made and many failures were encountered before a practical and effective technic was developed. This technic included the development and popularization of three definitely new agencies: the public health clinic, the public health nurse and the systematic program of popular education. Each had, it is true, been used before, here and there, in various ways and for different purposes, but it was in the attack on tuberculosis that they were fully developed, accurately coördinated and systematically applied. These agencies, establishing for the first time continuous and effective contact between the health agency and the mass of the people, are at once the most characteristic and the most valuable contribution which America has made to modern public health.

About the same time, also, health officials began to work in the public schools. First entering the schools only for purposes connected with the control of communicable diseases of childhood, these men, physicians all, were strongly impressed with the deplorable physical condition of the children they were called upon to examine. From these observations came the impetus for the inauguration of a systematic effort to improve the health of these adolescents for whose education the state had already assumed full responsibility. The sequel is familiar to us all. In any well-organized educational system each child is examined on entrance to school and kept under regular observation thereafter. Nurses are provided to convey to the parents a report of the results of the examination and to secure the correction of the defects found. Other means failing, special clinics are organized and operated for the correction of such cases as cannot otherwise be corrected.

The development of the program of infant hygiene is so well known

as to need only passing comment. The first agency employed was a milk station, dispensing to the mothers of needy infants milk of good quality and modified to a proper formula. It was found early in the work, however, that babies are not saved by milk alone. From the milk station was evolved the infant welfare conference, now everywhere the basic unit of infant welfare activity. The welfare station was not consciously planned. It developed spontaneously in many different places as the logical answer to an actual need. It rests upon the fundamental assumption that mothercraft is a difficult and hazardous business, and that mothers can best be assisted in rearing healthy babies by a system of continuous supervision in which the mother and the baby are seen at regular intervals by a physician and in which the mother is aided in carrying out the doctor's directions by the visit of the nurse to the home.

The gap between infancy and school life, so important to the development of a sound physique, is being bridged by an extension of this system of medical and nursing supervision to cover the whole of the first six years of life.

The saving of infant lives which has everywhere followed the adoption of this plan has not, however, been very effective in preventing mortality during the first month of life. Being a baby under one month, and particularly under one week of age, is still the most dangerous of human occupations. The effort to prevent neonatal and early infant mortality involves the extension of the plan of continuous supervision back through the puerperium and, in fact, to the early weeks of pregnancy. At present such prenatal care and delivery service is being given by health departments and welfare organizations only in a limited and experimental fashion; but if the past is an adequate guide, such a system will soon be regarded as a necessary and usual function of any health organization.

We see, therefore, clearly outlined, the framework of a plan of continuous medical supervision for health which, as already developed, covers the whole period from early pregnancy to the end of ordinary school life. This plan is in partial operation throughout the country, and is here and there and at present only on an experimental basis, being carried on in practically complete detail.

While this system of medical supervision of infancy, childhood and adolescence has been in process of evolution, other movements of importance have developed: the colleges and universities of the country, feeling keenly their responsibility for the physical welfare

of their students, have developed health and medical services which provide for their students the same sort of supervision.

The movement for periodical health examination is essentially only a further extension of the scheme to cover the whole period of adult life. Industrial medicine in its full development is another and most important expression of the same idea.

It is somewhat surprising that this plan should have proceeded in detail so far toward complete realization without more general recognition of the basic idea which is in process of evolution. We are continually discussing this or that individual procedure, but we seldom or never discuss the ideal to which the detailed procedures are relatively of secondary importance.

It may be remarked that our present attitude to the subject is quite typical of the genius of the Anglo-Saxon peoples. We resolutely refuse to consider the broader logical and philosophic aspects of a problem, while we are actually engaged in working out in practice the detailed procedures which will finally bring us in effective reality to the consummation of an ideal.

If our reasoning so far is sound, and our premises correctly stated, we must conclude that the public health of the future will be based on a system of continuous medical supervision for health, including every citizen, whatever his degree or station, and covering the entire period from conception to final dissolution. One might be tempted to infer at this point that should eugenics become a program instead of an ideal, the moment of conception will be too late for the proper initiation of this plan of supervision.

Letting our minds run, for the moment, far ahead of our facts, it is not difficult to visualize what might happen, in the not too distant future, when the wife of a citizen of the great middle class, who will have been, we hope, eugenically advised, becomes aware of the existence of a pregnancy. She at once visits and is registered at the neighboring prenatal clinic. There she is examined by an obstetrician, advised as to her diet life and habits and sent home to be visited regularly by the nurse, who assists her in carrying out the doctor's orders. She revisits the clinic at stated intervals, more frequently with the advance of pregnancy. Specimens of urine are collected and examined at regular intervals and treatment is provided as necessary. On the approach of labor she enters the maternity hospital for delivery, or if she prefers to remain at home, proper obstetrical and nursing care is there provided.

From the maternity, mother and infant pass to the welfare center, where medical and nursing supervision are supplied for the whole of the first six years of life. During this period the child is immunized against smallpox, diphtheria and perhaps other diseases. The teeth receive attention immediately upon eruption and continuously thereafter. The organs of special sense are examined and necessary corrections are made. The tonsils and adenoids are removed as the indications necessitate. Special conditions involving infection with or exposure to syphilis or tuberculosis receive appropriate attention. The psychologist and the psychiatrist are at hand to examine and treat cases falling within their special provinces.

The child, at six years of age, enters school in the best possible condition. During school and college life supervision continues. Children falling out of step with the group for any reason are specially watched. There are separate classes for the undernourished, the deaf, those visually defective and those mentally abnormal. The teeth and the special senses are not neglected.

By the end of his educational period the aspiring citizen will have been thoroughly grounded in personal, community and sex hygiene; his appendix will, usually, have been removed, and he is fitted to take his place in the world of commerce or industry, always with the understanding that he is to visit his physician and his dentist once in six months, the ophthalmologist every one or two years and such other specialists as his inclination may suggest and his purse may afford. The gall bladder, the pylorus and the inferior half of the thyroid will be relinquished as circumstances demand.

It is difficult to survey such a program with an eye that is not at once amused, skeptical and horrified. Objections in floods leap at once to the fore. The tremendous cost of the scheme, the enormous personnel required, the loss of individual initiative, the dangers of political interference, the sacrifice of the private practitioner—these and many like them immediately suggest themselves. Each of us, from the background of his own mind, with its intensely personal philosophy, its jealous regard of its own and its owner's interests, its judgments and its prejudices, marshals his opposition, and with justice, to so preposterous a conception.

Your speaker should, perhaps, hasten to explain that this scheme is not his own favorite brain-child. He is not in any sense its originator or its proponent. It represents only his conclusion as to what is going to happen, based on his observation of what has

happened in the last two decades and what is happening before our eyes at the present moment. It is a prophecy, subject, in an unusual degree, to the fallibility of all human efforts to see around the corner. It is, however, a deliberate prophecy, and from this standpoint we will proceed to its examination.

Let us assume for the moment that we are correct in our conclusion that the present trend of development is toward the creation of an organized system of continuous medical supervision to replace our present unorganized and discontinuous plan of medical service. The question at once arises, does the new system offer reasonable hope of substantially better results than are obtained under the present plan? The answer to this question must, in our opinion, be yes. We have accumulated a great body of knowledge regarding both the cure and the prevention of disease. All here present believe that this knowledge contains almost immeasurable possibilities for the improvement of man's physical and mental well-being. We are applying this knowledge as individuals to individuals, or through existing organizations to considerable groups of the population. Results so far obtained have been almost universally satisfactory. Organized group practice, organized health services, hospital clinics, university and industrial organizations all grow apace and commend themselves to their patrons and to those who conduct them. Every practitioner needs and utilizes as best he can the services of specialists and technicians of various sorts, and works in his own way to a more satisfactory relationship with his patients. If our vaunted medical science is true, and is potentially of value to the world, the problem of its efficient and universal application must ere long be faced and solved.

The question of the probable cost of establishing and operating such a plan need not discourage us. Our medical expenditures, under the present plan, probably exceed one billion dollars per annum. The cost of operating our present health system, as such, does not greatly exceed fifty million dollars a year. The additional cost of a combined organization such as we have visualized would probably not be great, certainly not ponderable in our present scale of rational expenditures. It may safely be assumed that the American people can afford an adequate system of medical service.

When we come to possible methods of organizing such a service the way is not so plain. The familiar specter, "state medicine," bars our way. Our minds run to thoughts of a great government

bureau employing thousands of mediocre physicians who, secure in their places on the public pay-roll, perfunctorily carry on the delicate and important tasks of medical and surgical care and prevention. We imagine these great organizations dominated by those politically-minded members of the profession with whose activities we are frequently so sadly familiar.

We must clearly understand at this point, however, that the adoption and general application to our population as a whole of a policy of continuous medical supervision for health, does not at all imply that the service as a whole be rendered by a single organization or that it be conducted in whole or even in major part at public expense. No sanitarian of recognized standing in the profession wishes or advocates the establishment under public auspices of a system of "state medicine" serving the whole population. Those who have had practical experience in operating our existing public health services know too well the difficulties and dangers of attempting to render sound and efficient medical service under government auspices. These difficulties increase rapidly with the size of the organization and with the size of the population to be served. They are almost insuperable in our larger cities today. A single organization serving the nation, or even a large state, is practically unthinkable.

Every thoughtful sanitarian does, however, recognize the fact that in our population there is a class, and a large class, which is at present without medical service, preventive or curative, other than that supplied by private physicians as a matter of charity, or by hospitals, health and welfare organizations at the expense in one way and another of the public. He believes it to be the proper duty and responsibility of the official health agency in every community to organize and carry on, for the benefit of the members of this group, as adequate, complete and efficient a medical service, both preventive and curative, as is possible under the circumstances there existing. For this belief he is willing to give battle.

We cannot proceed further without defining, more accurately than has been done up to the present time, the limits, economical and social, of this special class. In our experience in Baltimore, which is probably not far from typical of American cities, we have found that about 2½ per cent of the population are definitely pauperized; that is to say, are regularly the recipients of material aid at the hands of our agencies of relief. No one will question the need and pro-

priety of supplying medical service, preventive and curative, to this group. A really effective medical service might well reduce appreciably the number of persons in this class.

Next in the economic scale we find a very large group, the members of which, under favorable circumstances, manage to provide for themselves the bare necessaries of life—food, clothing and shelter—but whose economic resources do not run to doctor's bills or hospital fees. Idleness or unemployment may cause some members of this class to slip downward into the class of the dependent. During health and continuous employment they may actually have something left over for things beyond the bare necessities. The members of this class are largely made up of unskilled day laborers. Physical defect, lack of initiative, lack of education, slight mental inferiority or simple chance may be the factor that keeps them from rising in the economic scale.

It is not easy to say just how large this class is in any particular community. It is probably larger, usually, than most of us suspect. In Baltimore we have tried to estimate its size, using various methods, and we are convinced that it constitutes about 30 per cent of our total population.

This class is particularly deserving of our consideration in the matter of medical service. Its members are absolutely essential to our present social order. The fact that they exist to do the hard, disagreeable but essential tasks makes possible the enjoyment of culture, ease and luxury by the more fortunate. Its members are first to suffer in hard times. They are the natural prey of the unscrupulous, the charlatan and the demagogue. They have no organization and no spokesmen.

No physician worthy of his calling would seek to deny adequate medical service to the members of this essential and deserving class. The shame is that we should so long have insisted that this service be given as a charity, with the stigma that charity carries. Is it not better clearly to face the fact that our economic organization is defective, and that our social conscience must repair the defect completely if possible, but at least to the degree of providing an adequate preventive and curative medical service for these members of our society, as a matter of right and justice rather than of charity?

There is, of course, room for honest difference of opinion as to the exact minimum family income which is to be recognized as the upper limit of this class. This will perhaps never be satisfactorily defined.

Some who might pay something will always receive free service, and some will pay, even at the expense of the actual necessities of life. The detail does not, however, affect the principle. Whether the class constitutes 10, 20, 30 or 40 per cent of the population, it always exists, and its needs are always present. It may well be that with the future development of our social and economic life the size of this class may diminish greatly. That it will ever completely disappear does not at this time seem probable. So long as it exists it must remain the imperative duty of our governmental health agencies to provide for its members both adequately and efficiently.

We believe that in his effort to provide for these people the health officer may confidently expect the coöperation, support and approval of the members of the medical profession as a whole. This support and assistance should not, in my opinion, take the form of contributions of gratuitous professional service. Charity work for the poor may be the glory of the profession, but it is also the shame of the civilization which makes no better provision for its less fortunate members.

The most effective contribution which can at this time be made by the medical profession to this cause is an intelligent, sustained and vigorous effort to shield our public medical organizations from the baleful influence of political control. No one who has not himself endeavored to conduct a health department as an agency of government—local, state or national—can appreciate the full strength of that influence. It is sometimes insidious, sometimes brazen in its effrontery. It comes from many sources, through many avenues. It works always for a lowering of standards of service, a prostitution of ideals, a sacrifice of honesty and self-respect. Without the counsel and support of his professional brethren the conscientious health officer can oppose to these influences only the force of his own personality and the strength, usually of dubious value, of the small group of social and welfare workers to be found in every community.

Physicians constitute the only group in any community which possesses real understanding of the purpose and methods of work of our public health organizations. No other group is in position to judge whether or not that work is well done. Physicians may exert, as individuals and a class, an influence in public affairs out of all proportion to their numerical representation in the population. Whenever they choose to exert this influence they may insure not

only the efficient economical and nonpolitical administration of local health affairs, but, in addition and of equally great importance, that the conduct of these affairs be in harmonious relationship with the private practice of medicine in the community.

Another and equally important contribution which the medical profession may make to the improved administration of our public health organizations is a better recognition of preventive medicine as a specialty. It is a specialty requiring for its successful practice special education, training and experience, just as do other specialties.

There is, of course, much uncertainty and confusion of counsel at this time over the whole question of qualification for special practice. That the sentiment of the profession on the subject does exert a wholesome influence in the matter is not subject to doubt. A general practitioner no longer "does his own surgery" with the full approbation of his colleagues. The ophthalmologist does not expect to go directly into obstetrics without feeling the displeasure of his fellow-practitioners. Should we not feel and express the same sentiment when a physician, without any training whatever in preventive medicine, accepts appointment as health officer of a city of the first rank, and undertakes responsibility for the conduct of an organization spending millions of dollars each year and employing hundreds of people in delicate and important activities of whose very name our new specialist is ignorant? In a very real sense the good opinion of the group of which one is a member is the only effective agent for the control of human behavior. So long as medical opinion countenances the acceptance of responsible public posts by physicians obviously unfit to fill them, so long will politics rule our health organizations; charters, laws and regulations notwithstanding.

We have, up to this time, said nothing about the future development of our medical services for that part of the population not falling in the group of those now and in the future dependent on service at the public cost. It were perhaps better to leave the subject here, refusing to enter so speculative and controversial a field. There are some aspects of the subject which may perhaps be discussed without venturing too far into the realm of pure prophecy.

With the rich and the well-to-do we need not long concern ourselves. It is of interest that the opulent and highly placed in our population were first to apply in their own lives the principle of

continuous medical supervision for health. The court physicians of the medieval prince and the private physician of our modern Midas are familiar enough. Even when not able to employ the exclusive service of a physician, the rich and well-to-do of our time know well enough the value of medical service and have no trouble in securing it in any of its varied manifestations.

It is a familiar observation, however, that he who is neither rich nor poor fares least well in modern medical service. The skilled mechanic, the clerk, the small merchant, the teacher and minor professional man lack either that service which the rich provide for themselves or that which the public provides for the poor. Under usual circumstances, a member of these great middle classes comes in contact with his physician only when prevented by illness from going his usual way. His contact with the physician lasts only so long as the ailment from which he suffers. Confronted by an obscure complaint, he is sent by his physician from specialist to specialist, each of whom maintains a separate office, makes a separate charge, and more important still, lacks any knowledge of the patient other than that gained from his own examination. It is much as if, wanting shoes, an individual were forced to visit the leather merchant and the shoe-findings dealer, to obtain his materials, and then go separately to each of the one hundred and more workers among whom the labor of making shoes is now divided, each contributing his mite of labor, each maintaining a separate place of business and each making a separate charge. We might thus obtain shoes, but most would, I suspect, go barefoot or make our own. When our hypothetical middle-class patient is too ill to travel longer on foot, he may be fortunate enough to enter a good hospital, where for the first time he finds an organization embracing all the various sorts of people needed properly to diagnose and treat his condition and where in a wheel-chair, in a single morning, he can receive as much medical service as he could, under the usual conditions of private practice, general or special, obtain in two weeks.

Here, however complete and satisfactory his diagnosis and treatment may be, he finds himself compelled either to declare himself a pauper and pay nothing, or to assume a burden of debt that may require years of penurious self-denial to discharge.

Defective, expensive and unsatisfactory as may be the service of diagnosis and treatment available to the man of the middle class, it is far better than the preventive service at his disposal. He can

not now obtain at his own cost and by his own initiative anything approaching the sort of medical supervision for health so readily available to his fellow-citizen employed at day labor. Only by seeking the free service of the public health clinic may he obtain the benefits of organized preventive medicine.

This present plight of the middle class has not, of course, gone unnoticed. It has been the subject of much discussion by physicians and by the general public, discussion not always open-minded nor without heat. Many efforts have been made to discover a solution of the difficulty. Group practice, pay clinics, community hospitals, voluntary health insurance, even continuous medical supervision by a private physician for a fixed annual fee, have all been tried and are being tried here and there. Not one of these experiments can be regarded at present as offering great promise for the future. Experiment will undoubtedly continue, however, and we may confidently expect some day—not, we hope, too far distant—the development of a really satisfactory scheme. Once discovered, such a scheme will make its own way quite independent of our efforts to promote or to retard its progress.

Meanwhile, a sanitarian may venture to predict, on the basis of experience already had in public health work, certain features of this future and at present unknown system. This future medical service will, we believe, combine both prevention and cure. The line between the two, already worn so thin, will probably disappear altogether. Continuous medical supervision for health will require complete integration of preventive and curative methods and agencies. There is no apparent reason to suspect that under such a system the amount of medical service to be supplied will be less than that now required. It may well be far greater in amount, and as well in effectiveness.

The future service will, also, in all probability be given by definite organizations of physicians. Only by organization may we assemble the various specialists in their proper proportion, provide the necessary plant and equipment, and insure the financial stability of the enterprise as a whole. Only by management may we adjust the flow of patients to the available hours of professional service in a way to prevent waste and to keep the cost of the service within the means of the class to be served.

In his professional relationships, however, the future patient of the system will deal, not with the organization but with an individual

physician, the legitimate heir-at-law of the present general practitioner. No degree of efficiency in organization or administration, no amount of equipment, of laboratory service or of skilled special practice can in the least degree diminish the need for an effective and continuing personal relationship between each individual patient and some individual physician. This medical counsellor will have available and will utilize freely and fully the resources of the organization for diagnosis, for treatment and for education and home supervision. He must personally, however, assume full responsibility for the guidance of the patient as an individual, and may in this relation exemplify all that is best in medical practice.

Another and last essential of such a hypothetical development is, in my opinion, that it be supported in whole or in major part by the regular contributions of its members. Under present conditions the cost of a single illness may wipe out the lifetime savings of a middle-class family and may even burden them for years to come. A monthly or yearly service charge sufficient to cover the cost of the routine service and to provide a reserve for serious or prolonged sickness may well answer this question in a manner satisfactory alike to patient and physician.

We have wandered far afield in these vain imaginings, seeking, on the basis of past experience, to determine the course of future developments in a difficult and much confused field of human activity. If our conclusions are right or wrong, only the future can make certain. In any event we may console ourselves that human progress is always slow and usually orderly.

Social movements such as this do not always take account of the likes, dislikes, rights or interests of all concerned, but they do allow ample time for us to adjust ourselves, our ideas and our affairs to the new conditions. By the time the new conditions are really established we have of the old only a faint and not always pleasant memory.

In this progressive evolution of medical practice the sanitarian must play the part rather of a spectator than of a participant. If he properly discharge his obligation to that part of the population for whose health he is primarily responsible, he will find full occupation for both his time and energy. He cannot fail, however, to be an interested spectator. His own experience has been hardly won. He cherishes no illusions about the difficulty of attempting worthily to serve the demos in a present-day democracy. If his experience is

of value or his aid is desired he may be counted on to give of both freely and gladly.

More than all is he anxious that there be no conflict of ideal or of action between physicians and sanitarians. He believes that the difficulties which sometimes arise between them are, like most human difficulties, due to misunderstanding which can be avoided by common counsel and mutual respect. After all, Hygeia is the daughter of Aesculapius and she longs to dwell in the house of her father.

CERTAIN ASPECTS OF IMMUNIZATION IN COMMUNICABLE DISEASES OF CHILDHOOD.*

By JAMES M. ANDERS, M.D.

The subject of immunization against the diseases of childhood is quite extensive, hence I shall discuss only its more practical aspects, avoiding the mysteries and profundities of the laboratory side of the problem. Contributions to the groundwork of the scientific phases of immunization against this class of complaints have been numerous and noteworthy, but their application, in many cases at least, too long delayed.

Historic. In 1796, Edward Jenner established the principle of protective vaccination by showing that a susceptible person will be protected against an attack of smallpox by the previous successful inoculation with cowpox. Thus was secured an immunity to variola, and it marked the beginning of our modern ideas on immunization, although it had previously been held by the ancients (Hippocrates, Pliny the elder and others) that the causative factor of a disease was also potent to cure it.

As pointed out by Kolmer,[1] nothing further of importance was accomplished during the next eighty years, or until the first immunization by Pasteur based on the discovery of the specific microorganism of a virulent intestinal infection of chickens and their complete immunization by the inoculation of attenuated cultures of the causative bacillus. Similarly, in 1880, Pasteur immunized animals against anthrax. He next successfully established antirabic vaccination with attenuated virus.

Here it should be stated that our knowledge of the defensive reaction of the body cells against an invading microörganism we owe to Metchnikoff,[2] who is the author of the story of phagocytosis. In 1896, Fodor[3] discovered that the blood of the rabbit will kill anthrax bacilli in the test-tube independently of cells and phagocytosis, and thus was born the humoral theory of immunity. In 1890, Behring and Kitasato discovered antitoxins which, for a time, were held by these and other observers to be of great importance in acquired

* Read May 2, 1928.

immunity, but later evidence showed them to be efficient only in diphtheria, tetanus and, subsequently, cholera. It is now known that the phagocytic and humoral theories are fundamentally alike.

Diphtheria

We owe the development of a method of active immunization by means of toxin-antitoxin against diphtheria to von Behring and his assistants; but Babes, in 1895, and at about the same time Park, used it for the purpose of producing antitoxin in animals. In 1907, Theobald Smith[4] suggested its use for the purpose of producing immunity in man; but it remained for von Behring,[5] in 1913, to demonstrate the safety of the injections in human beings. Subsequently, Park and Zingher,[6] who have made wide use of this method of immunization against diphtheria, and numerous other observers, have firmly established both the safety and effectiveness of the procedure. Kolmer[7] states that in his experience in 88 per cent of Schick-positive children, three injections have engendered sufficient antitoxin to yield negative Schick reactions on retesting four months later.

There is available a diphtheria toxoid, which was prepared by Ramon, and to which the name anatoxin has been given. Its use is not attended by complications, or with rare exceptions at all events, according to Lesne[8] and other observers.

It is true that the accumulated data relative to the value of diphtheria toxin-antitoxin in the active immunization against diphtheria establish the efficacy of this protective device beyond all peradventure. Despite the fact that this safe and effective immunizing device is quite generally available, it has not been as promptly and as universally utilized as could have been desired. At the present rate of progress of the crusade against diphtheria the task of eradicating the disease will be far from completed at the expiration of the five-year period which it was freely prophesied by certain authorities, a few years ago, would witness the extermination of the disease. Happily, it may be rightfully claimed that the interval of time between the date of discovery of a scientific fact and its practical application has been steadily growing shorter within recent times.

In this connection data furnished by the Director of Public Health, Dr. A. A. Cairns, is of practical interest. The Philadelphia

campaign for the immunization of school children against diphtheria began in May, 1926, and has continued until this year, with the giving of three injections of toxin-antitoxin to pupils as follows:

May, 1926	37,000 pupils.
September, 1926	80,000 "
May, 1927	20,000 "
September, 1927	15,000 "
Total	152,000 or 58.7 per cent of the pupils.

It is also of interest to note that the decrease in the number of diphtheria cases in public school children is already quite evident, as the following tabulation clearly shows:

September, 1924, to June, 1925	856 cases.
September, 1925, to June, 1926	627 "
September, 1926, to June, 1927	493 "
September, 1927, to June, 1928	348 " (half school-year, 174 cases.)

It should be added that the number of minor contagious diseases encountered has been growing smaller each year as community standards of living have improved.

Dr. A. A. Cairns, Director of Public Health, has made careful plans looking to the immunization of the preschool-child of Philadelphia, commencing on June 6, 1928. Starting with prenatal care the babe will receive attention from its birth or as soon as the certificate of birth is received by the department. A visiting nurse from the Division of Child Hygiene will visit the home and instruct the mother in the proper care of her babe. At the age of six months the T. A. mixture will be administered and immediately thereafter vaccination against smallpox performed.

There are ten health centers and four leading hospitals at which the preschool-child will be given diphtheria toxin-antitoxin. The Department of Public Health has also entered into an agreement with the Board of Public Education whereby the latter will open seventy public school houses between the hours of 3.30 and 4.30 P.M., to which parents will be urged to bring their children of preschool age. The physicians in charge of all immunizing stations will be furnished by the Department of Public Health. This is an important step on the part of the Department of Public Health, since it is well known that the younger the child the more susceptible it is to the disease, after six months of age, and also that most fatal cases occur in children under five years of age. Heretofore, children at

this early period of life have been reached only within quite narrow limits.

Dr. William H. Park,[9] of the Department of Health, New York City, reports that about 50 per cent of the youngest school children (first four classes) had been injected and about 30 per cent of the oldest children in the public and parochial schools. He further states that a number of preschool children immunized by the Department of Health of New York City is only about 4 per cent, and, further, thinks it could be said that ten per cent of preschool children have been immunized by private physicians and Health Department inspectors. In short, the preschool age has hardly been touched, while only about half of the youngest classes in the primary grades have been immunized. Dr. Park kindly sent a tabulation of 441,000 New York City school children, setting forth the percentage of Schick-positive and Schick-negative cases, as follows:

441,000 Children Tabulated as to Result in Schick Test

	Schick, positive.	Schick, negative.	Total No. children Schicked.
Under 5	2,483	1,088	3,571
5 to 6 yrs.	9,427	5,610	15,037
6 to 7 yrs.	23,857	18,817	42,674
7 to 8 yrs.	25,664	26,263	51,927
8 to 9 yrs.	23,569	30,450	54,019
9 to 10 yrs.	21,338	33,121	54,459
10 to 11 yrs.	19,070	33,531	52,601
11 to 12 yrs.	17,206	33,023	50,229
12 to 13 yrs.	14,484	30,246	44,730
13 to 14 yrs.	10,728	25,411	36,139
14 to 15 yrs.	6,219	17,730	23,949
Over 15	3,360	9,227	12,587
	177,405	264,517	441,922

Positive = + and ± Negative = + and −

The technique of toxin-antitoxin injections as carried out by Dr. Walter S. Cornell, in Philadelphia, is as follows: A 5-cc. Luer syringe with a steel slip-on needle of 24-gauge and length $\frac{3}{4}$ inch is used. As the dose of the toxin-antitoxin is 1 cc., the syringe therefore holds sufficient for five injections. The glass barrel is graduated and the physician who is doing a large number of injections simply fills up the syringe, injects 1 cc. into the first child, the second cubic centimeter into the second child and so on into the third, fourth and fifth. Regarding the sterilization of the needle between injections, we have contented ourselves with the practice of momentarily

immersing the syringe in alcohol, wiping it against some cotton or gauze which is immersed in the alcohol. We cleanse the child's arm immediately before the injection with some alcohol on a pledget of cotton, which is at once discarded. The injection is best given intramuscularly, there being less likelihood of inflammatory reaction than one given hypodermically, although the immunizing result is the same. It is believed that the best site is high on the arm into the body of the deltoid muscle. We have always given these injections in the warm weather in order to encounter the least amount of coincident illness.

It has been thought unwise to give the toxin-antitoxin in the month of September, when infantile paralysis is common, since those making the injections are practically certain to be blamed for any cases of paralysis that may follow the injections. The administration of the toxin-antitoxin consists of three injections of 1 cc. each, given one week apart.

In the Schick work, a 1-cc. Luer (glass) syringe of the tuberculin type is used. The material that is obtained from the Bureau of Health Laboratory calls for an administration of $\frac{1}{5}$ of a cubic centimeter for a dose. Each loaded syringe, therefore, suffices for five injections. The diluted toxin in the Schick test is injected intradermally, the needle is pushed into the skin very obliquely, care being taken not to pierce through into the subcutaneous tissue. The needle should be inserted sidewise into the skin, with the beveled side of the point facing upward, so that the operator can see that the beveled end is entirely inserted into the skin. Many operators push the needle a little further, in order that the serum will not leak back when the needle is withdrawn, but the further the needle is pushed the greater the danger of either getting too deep or having the point of the needle come up to the surface again. The success of the injection is shown by the formation of a visible wheal, which is white because of the blanching of the tissue by the introduction of the fluid.

In making this test, one must bear in mind the possibility of a pseudoreaction, due to foreign protein. The pseudoreaction occurs more rapidly than the Schick reaction, being at its height in twenty-four hours, and being pretty well faded at the end of forty-eight hours, and ordinarily entirely faded at the end of seventy-two hours. On the other hand, the true Schick-test reaction does not come to its climax for three days, and does not fade until about a week after the

injection, usually with a pigmentation process long after that time. Schick work is being done only in the first three grades; that is, with young children. Because older children are more sensitive to foreign protein, it is the accepted practice, when Schick-testing these older children, to do a control test, using inactivated Schick toxin in the other arm, so that accurate information regarding the pseudoreaction will be at hand.

The clinician cannot afford to ignore the triumphs of the laboratory, but should become sensible of his responsibilities and inform parents of young children of the importance of having them immunized after the age of six months. If he were to appreciate the duty naturally devolving upon him in this respect, he would carry on such instructional efforts zealously and systematically.

True it is that there is, on the whole, little public demand for this prophylactic service if we except the limited enlightened element of the laity. The lesson of protection against this disease, therefore, has not as yet been driven home in the majority of homes in which children are popular. The question arises, Cannot the medical profession be justly assailed as neglectful of using its full influence individually and collectively to the end that the task of eradicating diphtheria may be speedily accomplished through the employment of available means?

This is not the time or place to embark on a full discussion of the practitioner's duty toward a subject of such complexity as immunization in the communicable diseases of childhood; but he should accept facts, experimentally proven, that are vitally important to the welfare of mankind; his attitude should be distinctly and actively coöperative in the matter of their practical application.

Coöperation between the medical profession and the public is steadily growing closer, chiefly through the efforts of professional organizations and municipal and federal health agencies, as well as civic associations. The chief spur to activity in the work of immunizing childhood against diphtheria has come from public health departments and local boards of health. It would appear that voluntary civic and welfare organizations, like the medical profession, might have been more active in attempts to popularize immunization against diphtheria than they have been in the past.

A further pressing need of the present immunizing campaign against diphtheria is the education and crystalization of public opinion favorable to immediate and universal application of a potent

and nonirritating anatoxin. This urgent requirement demands that medical organizations and individual physicians, as well as civic welfare bodies, give their united support to the health departments and local boards of health in a task that is only half-finished, if all children of susceptible ages be considered. Finally, the present situation affords an exceptionally good opportunity to inaugurate such a movement in this direction.

Scarlet Fever

Historic. In 1923, the Dicks[10] found that certain strains of streptococci have a causal relationship to scarlet fever. Gabritschewsky had previously (1907) offered proof in favor of accepting a streptococcus as the specific cause of scarlet fever, but his death prevented him from completing his observations. During the course of further investigations the Dicks made skin tests with standardized toxin and later still produced experimental scarlet fever.

Johan,[11] of Hungary, Dick-tested about 17,000 individuals, using a control in each case, and immunizing all who gave a positive reaction. He found that 5.3 per cent of all reactions were pseudo-reactions, and further points out that it is difficult to draw a sharp line between weak positive and negative reactions, so that a large number of the former might influence the total percentage of positive reactions. In order to reduce the error due to differences in reading the reactions, and the sizes and the degrees of these, he etched circles of 10, 20 and 30 mm., thus analyzing his skin tests according to the degree of the reactions. Of 1005 Dick tests, 49.5 per cent gave a weakly positive reaction, but this percentage is lower in the first few years of life. Johan found that a very high percentage of weak (+) positive reactors could be immunized with a small amount, or a total of 3000 skin-test doses, while a much larger dose was necessary in the stronger (++ and +++) positive reactions. The foregoing facts, he thinks, may explain discrepancies in results obtained by various observers in immunizing with the same dosage. Johan tested 38 convalescents and found 1 positive reactor.

Zingher[12] performed 7700 skin tests, which gave about the same results as Johan's data, just quoted.

McEntree's[13] studies lead him to conclude that the Dick skin test is helpful, but not reliable as a guide to diagnosis, although a Dick

negative reaction indicates a high degree of antitoxin immunity. He states that a polyvalent serum would give a more reliable indication of susceptibility.

Kinlade, Smith and Taylor[14] claim that the Dick test is of some value in diagnosis, but the value is limited. They continue: "The future, however, will undoubtedly see the Dick test in relation to scarlet fever as firmly established as the Schick test is in relation to diphtheria."

Bauer[15] states that the laboratory must work out a more efficient toxin than those available, which cannot be recommended for public use. He found the Dick toxin unreliable for immunizing purposes, and ascribes the discrepancies in the results obtained by different observers to lack of uniformity in the standardization of the toxin and antitoxin of scarlet fever. Until the Scarlet Fever Commission evolves a method by which toxin and antitoxin may be uniformly standardized, the medical profession will not be justified in urging the general adoption of these agents as means of cure and prevention.

Park,[16] of New York City, does not advise immunization against scarlet fever except in localities where it is at the time prevalent or expected to spread, for the reason that children fail to hold their immunity when given even five injections. Diphtheria toxin-antitoxin is slow in acting, but gives lasting results. On the other hand, scarlet fever immunization is equal in action, but not lasting in results. He, however, recommends immunization against scarlet fever in institutions where there are apt to be examples cropping out from time to time and where serum has not only the disadvantage of producing serum sickness, but of not lasting more than a couple of weeks. He has had absolutely no accidents from toxin-antitoxin and does not believe that the tiny amount used sensitizes the children to any appreciable degree. It is interesting to note that a shift from horse antitoxin to goat antitoxin has been made in New York City, because some people fear the very small amount of horse antitoxin used.

McBrown[17] employed Larson's diphtheria and scarlatina vaccine combined in 955 males and 976 females, giving three injections, one week apart. He states that they do not produce any greater reactions than when given alone, but are effective. G. Ramon[18] also advocates the use of the method of associated vaccinations; it consists of the injection of mixtures of two anatoxins, *e.g.*, against diphtheria or tetanus, or streptoscarlet fever. Mixtures of typhoid

vaccine T.A.B. and anatoxin against diphtheria, he claims, result in a greatly increased antitoxic immunity.

Kinloch, Smith and Taylor[19] claim that a potent nonirritating streptococcus anatoxin has been prepared which they believe will profoundly facilitate immunization against scarlet fever. Surely the newer methods of immunizing should be, when perfected, applied without delay, but are not being widely employed at this writing. Further steps in the ordered progress of investigation into active immunization against scarlet fever and its serum treatment are awaited with zealous interest.

Measles

Tunnicliff and Taylor[20] found that the green-producing diplococcus associated with measles (a disease which occurs only in man) produces an extracellular toxin which gives a definite skin reaction in persons with a negative, but not in persons with a positive history of measles. Further observations will be, however, required before an accurate estimate of the value of their results can be made.

John A. Toomey[21] reports on the intramuscular injection of 190 susceptible persons with measles convalescent serum as a prophylactic measure. No serum was given when the history of exposure exceeded six days; and it was obtained from donors eight days after the rash began to disappear. After the injections the susceptible exposures were allowed to come in frequent and close contact with measles cases. Of 190 persons injected, 173 were protected, while the remaining 17 developed attenuated measles.

In the latter part of 1925, at the Contagious and Pediatric Division of the Cleveland City Hospital, Babies and Children's Hospital, and in the private practice of several pediatricians, 199 patients exposed to measles were protected, in only 4 of whom measles developed. The usual dose of convalescent serum employed was 3 cc.

Dr. Samuel Woody, director of the Philadelphia Hospital for Contagious Diseases, has, since 1924, employed convalescent serum, taken about one week after the rash has begun to subside, and found it to be effective. In 1925, during the busiest scarlet fever season this hospital has ever known, a measles outbreak of unparalled proportions occurred in the same wards. To meet the situation with convalescent serum was wholly out of the question, so that,

instead, whole blood, an ounce or two taken from the parent and injected into the thigh muscles of the patient, was used with success. Parental whole blood and convalescent serum have thus robbed measles of its terrors as a cross-infection. At this writing whole blood is used, since it is more easily obtainable in sufficient quantity. A word of caution should be spoken here. I am strongly of the opinion that the condition known as roseola is sometimes mistaken for measles. So-called German measles, however, should be, and as a rule can be, distinguished from true measles.

Chickenpox

Vaccination of exposed varicella patients with the contents of the vesicles has recently been practised, but is not new. Greenthal[22] has had the opportunity of testing the efficacy of varicella vesicle fluid in checking the spread of this disease, and his experiments show that the method is effective. Vaccination should be performed on the first or second day of exposure. He gives minute directions for the procedure, which was employed in 36 persons, of which there were 19 "takes" and 16 negative reactions. Doubtless, some of the patients who gave a negative reaction had had varicella before. It seems to me that the strictest precaution should be taken to avoid the use of vesicle fluid from syphilitic patients. Further experience, with a view to confirming active immunization against chickenpox, is needed to determine the value of the method, although, on *a priori* grounds, it would appear to be most promising. Mitchell and Fletcher[23] stress the fact, which clinical experience confirms, that a considerable number of adults contract this disease.

Whooping-cough

The pioneer discovery, in 1906, of Bordet and Gengou,[24] of the Bacillus pertussis has led others to appreciate the value of bacteriologic methods in the diagnosis of this disease. No concerted effort, however, has been as yet made to immunize children against whooping-cough. Certain individual reports give promise of future success, more particularly with convalescent serum, although less successful as a method than in measles. On the other hand, the use of vaccine as a prophylactic and therapeutic measure seems to have fallen into disrepute among certain observers who have had experi-

ence of its use during the past few years (Russell[25]). Huenekens,[26] however, recites evidence from the literature supporting the prophylactic value of pertussis vaccine.

C. J. Bloom[27] is enthusiastic about the prophylactic effect of the vaccine in institutions. He found it successful in 304 out of 308 cases immunized against pertussis. His technic is as follows: "(1) The mixed vaccine is used, each cubic centimeter containing 5 billion pertussis bacilli and 3.5 billion influenza bacilli; (2) this vaccine is given ten days after it has been prepared; (3) 1 cc. is given on alternate days for three doses, then 1 cc. every second year if complement-fixation test justifies it." It would appear, therefore, that pertussis vaccine is the best instrument available for prophylaxis against whooping-cough.

Smallpox

With reference to vaccination against smallpox, little need be said. The fact that the Philadelphia native population continues year after year practically without any cases of the disease is due to the strict school vaccination law of the State, which has been vigorously enforced by Dr. Cairns, Director of the Department of Public Health, Philadelphia. The division of Medical Inspection of Public Schools carries a memorandum list of some 500 pupils who are apparently immune to the disease by reason of revaccination annually required. It is quite probable that most of these are successfully vaccinated, but their marks having gradually become indistinct.

Cole,[28] in speaking of the origin of physicians, points out that they have been employed by the sick to heal them from earliest times, so that physicians could not be wholly disinterested seekers after truth. While this is still the duty of the medical profession, its members will, in the future, strive to prevent disease, and to this end they must become more expert and more zealous in the application of the means of securing artificial immunity against the communicable diseases, particularly of childhood.

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ACUTE INFECTIOUS POLYNEURITIS WITH FACIAL DIPLEGIA*

By CLARENCE A. PATTEN, M.D.

Acute infectious polyneuritis with facial diplegia is interesting because of its infrequency and because of its etiology. Three cases of this type have come under my observation in the past six months.

The history of the first case is as follows:

The patient is a male, aged thirty-one years, a civil engineer by profession, married and has one healthy child. The family history is entirely negative, except that one maternal uncle died of pulmonary tuberculosis. The past medical history shows that the patient had measles, mumps and chickenpox in childhood, and each winter has suffered from tonsillitis, with tonsillar abscess on two occasions. His history is clear so far as excessive indulgence in alcohol or tobacco is concerned, and venereal disease is denied by name and by symptom.

The present illness began about the first of December, 1927, with a laryngeal cold, which in a few days' time had extended to the trachea and bronchi. A persistent and troublesome cough developed, which continued for some weeks, and was accompanied by copious expectorations of a greenish-yellow material. There was no fever at first, but about two weeks afterward he had a temperature of 101° to 102° F. for two days and profuse perspirations at night. A little later he developed pain in the lower left chest, which was not aggravated by deep breathing, but, as he stated, seemed to be on the outside. It encircled the abdomen, was aggravated by cough and kept him awake at night. There developed also a queer pulling sensation in the eyes, which led him to consult a physician, who thought the trouble might come from a sinus infection. At this time severe pain developed in the lower extremities, and two days later in the arms. The pain is described as excruciating, and seemed to pervade the whole body. He did not feel particularly weak, but was "sore all over." In the meantime, however, he continued working and, as had been his custom for a number of years, worked late into the night, getting an insufficient amount of sleep. On December 30 and 31, 1927, he was driving his car in very inclement weather. It was foggy and windy, and he was obliged to lean out of the window of the car to see the road. On December 31 he noted a marked stiffness and soreness in the muscles of the neck and jaw. The whole lower jaw ached, and there was a small patch of herpes on the right corner of the lower lip, which lasted about four days. When

* Read June 6, 1928.

he got up on January 1, 1928, he noticed difficulty in closing the left eye, and that he talked from the right corner of his mouth, his face being drawn to the right side. Within a few hours there was a complete paralysis of the left side of the face. Two days later there was a similar involvement of the right side of the face. During this time the pain in the arms, chest and back had become much less severe, but sleep was very much interfered with. He had, however, a fair appetite, and his bowels, which had previously been in excellent condition, now becomes costive, and it was necessary to resort to salines.

The patient came to me four days after the onset of the paralysis of the left side of the face, and two days after the involvement of the right side of the face. The chief complaint was a bilateral paralysis of the facial muscles, with pain, soreness and aching in various parts of the body.

The neurological examination showed pupils that were slightly irregular and unequal, but which reacted promptly to light, though through a small arc. There was a distinct paralysis, of the peripheral type, of both seventh nerves. Hearing, vision and the sense of smell were normal, but the patient complained of a subjective disturbance of taste, which could not be verified by objective examination. The cranial nerves were otherwise normal, except for a moderate tremor of the tongue. The movement of the extremities were normal in range, but reduced as to power. The reflexes were all present and active, and there were no evidences of pyramidal tract disease. Coördination was good, and no tremors or muscle atrophy were observed. There was an indefinite impairment of vibratory sensibility in the distal portion of the extremities. The gait and station were unimpaired. There was distinct tenderness on deep pressure over the large muscle groups and an indefinite tenderness over some of the nerve trunks.

The general physical examination showed a man of the apparent age, with an extremely toxic appearance, badly coated tongue, foul breath, infected tonsils and injected pharynx. The thoracic and abdominal viscera were negative to all methods of examination. The genitalia were likewise normal and there were no deformities of the extremities. The teeth seemed to be in very good condition and on *x*-ray examination no evidences of disease were found. The urine was negative, with a specific gravity of 1.014. The blood count showed 4,160,000 red blood cells, 8100 leukocytes and a hemoglobin of 85 per cent. The differential count was 71 per cent polymorphonuclears, 22 per cent lymphocytes and the remainder mononuclears and transitional cells.

The spinal-fluid examination showed a cell count of 2, an increased globulin, a negative Wassermann reaction and a colloidal-gold curve of 2555432210. The blood Wassermann was negative in all antigens. Electrical reactions of the facial muscles showed normal responses on both sides of the face, but better on the right than the left.

The patient was kept in bed, elimination was pushed, the diet was restricted and pain was controlled largely by means of codein and the salicylates, while luminal or veronal were used to produce sleep. Light massage was instituted for the paralysis of the face and in a few days a very mild galvanic stimulation. He was kept in bed until all pain and soreness had

disappeared, and during this time repeated examinations failed to reveal any other evidence of muscle paralysis, atrophy, fibrillary twitchings or a loss of reflexes. Improvement began in the right face about ten days after the onset of the paralysis. In fifteen days beginning voluntary motion was observed and improvement was steady, although more rapid on the right side than the left.

A second case coming under my observation was that of a boy, aged seventeen years, with an irrelevant family and past medical history:

The patient had been for some time considerably run down, possibly from overwork or other unknown causes, and for a month prior to the onset of the present illness said he had been "headachey" and felt "groggy." He had an attack of so-called "acute indigestion," with a rise in temperature, nausea, vomiting, headache and general malaise. The acute symptoms cleared up in two days, but he did not feel particularly strong or well afterward. In two weeks' time he developed severe and excruciating pain in the legs which kept him awake at night, and during which time he had profuse perspirations. There was marked fatigability of the muscles of the thighs and legs, and walking became very difficult. Two days later the pain had advanced to the thighs, and in four days the trunk and arms were involved, but with less severe pain than in the lower extremities. At this time walking became impossible and he was confined to bed. Shortly after the onset of the marked weakness of the muscles of the lower extremities he became conscious of a definite weakness of the upper extremities, and at the same time a paralysis of the right side of his face. By the time the face had become paralytic the pains had lessened, and shortly thereafter cleared up in the order of appearance, *i. e.*, lower extremities first. The extreme weakness of the lower extremities lasted about two weeks, and it was at this point that the patient was admitted to the hospital.

Physical examination showed a rather pale and undernourished adolescent with a right facial paralysis and a moderate wasting of the muscles of all four extremities. The teeth were in good condition, but the tonsils were obviously enlarged and infected. The chest and abdominal visceral examinations were grossly negative. The laboratory studies revealed no findings except on one occasion a leukocyte count of 9400.

The neurological examination showed normal pupillary responses and no oculomotor palsies. The right seventh nerve was completely paralytic and the left was definitely impaired as to motor function. There were no disturbances of vision, hearing, smell or taste, and all tongue and pharyngeal motions were well preserved. The upper extremities showed considerable wasting of muscles and loss of power, but a normal range of motion. The biceps and triceps reflexes were hyperactive. The abdominal reflexes were present and equal. In the lower extremities muscle power was considerably impaired, particularly the extension of the legs. There was considerable muscle wasting, but all movements were possible. The knee reflexes were

present and active, but the ankle reflexes were diminished. There were no disturbances either of superficial or deep sensibility. Coördination was good in all four extremities and the station was normal. His gait was a little awkward because of the weakness of the lower extremities.

A third case, which is less typical, is that of a boy, aged eight years, with the following history:

The patient had had a slight cold with swelling of the right neck three weeks before admission to the Delaware County Hospital. He had recovered from this without incident, when suddenly, eight days before admission, he developed nausea and vomiting, associated with some fever and marked prostration. He vomited for three days and complained of epigastric pain. Then pain appeared in both lower extremities, but more marked on the right side than the left, and with very definite generalized tenderness. The pain soon involved the upper extremities and the trunk. At the time of his admission to the hospital he had very little pain but a very marked paralysis of the muscles of the thighs and upper arms. The muscles of the forearms and legs were very weak, but motion was still present. He was afebrile when admitted, and showed no evidence of infection so far as leukocyte and differential counts were concerned. Spinal fluid examinations were made on two occasions, and found to be negative in all respects.

At the time of my initial observation he showed the following: Normal vision and ocular movement. No fifth nerve involvement. A definite weakness and lack of expression in the face, bilaterally, although when commanded he could weakly wrinkle his forehead, show his teeth and close his eyes. Objectively, there were no other cranial nerves involved, but the hospital notes contain a record of marked difficulty in swallowing during the forty-eight hours preceding my examination. The chest muscles were apparently paretic on the left side. There was very little abdominal movement and respiration was apparently carried on largely by the muscles of the right chest. The biceps and triceps reflexes were absent, but there were no sensory disturbances. Both lower extremities were completely paralytic and the reflexes were totally abolished. No sensory disturbances could be elicited.

The problem in diagnosis in the first case presented no comparative difficulty, but several possibilities had to be considered. In the first place a basal meningeal syphilis is one of the most frequent causes of facial diplegia. The slight irregularity and inequality of the pupils were the only clinical findings to support such a diagnosis, and it was definitely ruled out later by the negative serology of the blood and spinal fluid. Furthermore, there was nothing in the clinical history to indicate a luetic infection. A second possibility was a polioencephalitis inferior, involving the bulbar nuclei. This

diagnosis was not considered tenable because the facial were the only cranial nerves affected. In addition, the history of pain in various parts of the body, continuing over so long a period of time, is somewhat contrary to the usual history of anterior poliomyelitis. A third possibility in diagnosis was that of an ordinary multiple neuritis of toxic-infectious origin, but in this case many of the usual symptoms and findings were absent. There were no distal sensory disturbances shading off into normal areas proximally, such as are usually found in cases of severe multiple neuritis. In support of a diagnosis of multiple neuritis, however, a definite focus of infection was found in the tonsils, and there was a history of repeated tonsillitis and tendency to colds. I have never seen, however, facial diplegia in an ordinary multiple neuritis, although there are reported cases of unilateral paralysis. The diagnosis was made by exclusion and the rather typical history and findings as reported in the literature of acute infectious polyneuritis.

The second case gives a rather typical history of an acute infectious polyneuritis, but shows a variation in that there was only a mild weakness of the left face. The more marked involvement of the lower extremities is not unusual. Because of the obvious infection of the tonsils, a multiple neuritis from this source was definitely considered, but here again the absence of sensory disturbance, the marked motor weakness and the ascending character of the disease are differential points. It is true, however, that multiple neuritis, as pointed out by Patrick, may exist without sensory alterations.

The differential diagnosis in the third case was between a rather widespread anterior poliomyelitis and an infectious neuronitis or polyneuritis. I think the two main differential points are the ascending character of the disease and the intense and persistent pain. At first I was perhaps not entirely ready to dismiss the diagnosis of poliomyelitis, but certainly the features of the case showed a striking resemblance to infectious polyneuritis as it is described.

Discussion. Sir William Osler[1] was the first to describe this disease, under the term, acute febrile neuritis. Patrick,[2] in 1916, reviewed the literature, which covered 29 cases up to that time, and reported 3 of his own. Gordon Holmes,[3] in 1917, reported 12 cases of the disease. He considered that none were due to exposure, to metallic poisons or to local conditions, and by local conditions I believe he means focal disease. Bradford, Bashford and Wilson[4]

reported 30 cases (in 1918 and 1919) of acute infectious polyneuritis occurring in British troops in 1917, and Bashford established the etiology of the disease. He transmitted the disease experimentally from man to monkey and from monkey to monkey by subdural inoculations of emulsions of the human cord from a fatal case, and from the cord of an infected monkey to another monkey. The experimental disease was in all respects similar to the actual disease. Wilson confirmed Bashford's work by isolating the virus of infectious polyneuritis from Bashford's cases. He discovered an anaërobic organism 0.2 to 0.5 microns in diameter, round, oval or kidney-shaped, and arranged in pairs, in groups of five to eight or, rarely, in chains of three to five. Yudelson[5] reviewed the literature in 1927 and reported 1 case of his own, and Viets,[6] also in 1927, reported 2 cases.

All authors are agreed that the onset and course of the disease is fairly characteristic. There is usually a history of malaise, with a moderate rise in temperature of from 101° to 103° F., lasting from two to four days. These symptoms clear up, and, though not acutely ill, the patient as a rule complains of not feeling quite well for a period of three to six weeks. There may be a certain amount of muscular weakness and some generalized pain during this time, but sooner or later there ensues a period of intense pain in various distributions with the onset of weakness or a definite paralysis in various groups of muscles. In the majority of cases the paralysis begins in the lower extremities and in a few days' time the upper extremities are involved. At about the time of the involvement of the upper extremities there occurs a paralysis of one or both sides of the face, which lasts indefinitely from a few weeks to several months. In the severe cases there is marked foot and wrist drop, with absence of all of the tendon reflexes, some impairment of deep sensibility, sphincteric disturbance, and at times involvement of other cranial nerves than the seventh.

Improvement is indicated first by a diminution of the pain. After a short time the pain largely disappears and a gradual return of power in the muscles is noted. The face is usually the most completely paralyzed and is the last to recover. Death occurred in 2 of the 12 cases reported by Gordon Holmes, and in 8 of the cases reported by Bradford. When death occurs, it is usually within the period of the first two weeks after the onset of pain and paralysis.

In many respects a fatal case may bear a strong resemblance to Landry's paralysis, and the type of case which has been reported by various authors under the heading of infectious neuronitis.

In the recoverable cases there are all degrees of motor impairment and pain. As above mentioned, the more severe cases show foot and wrist drop. Milder cases may show only absence of the tendon reflexes and some generalized weakness. The pain in these cases is variable, but for the most part resembles a typical neuritis. It is oftentimes severe, causing extreme discomfort. Not only is there pain, but there is also marked tenderness over the nerve trunks, and the patients complain of soreness in parts or the whole of the body. The distribution of the pain and paralysis is usually symmetrical, and in practically all cases one side of the face is paralyzed twenty-four or forty-eight hours before the other. Mentally the patients are always clear, and there is no recorded case showing confusion or delirium. During the stage of acute pain and onset of paralysis they are usually febrile. In some cases a moderate leukocytosis has been observed. In all cases the spinal fluids have been practically negative, except an alteration of the gold curve in 1 case reported by Viets and my first case. In the nonfatal cases complete recovery can be looked for in from six to eight months.

Bradford is very certain that a distinct difference exists between ordinary cases of multiple neuritis and the type under discussion. He states, in part, that "bilateral affection of the face, generalized weakness rather than actual paralysis of individual muscles, the progressive nature of the palsy and its ascending character, together with the curious manner in which the proximal segments of the limbs are mainly involved, are all striking features of the disease, and are not familiar observations in other affections of the nervous system."

Pathologically, evidences have been found of an acute degenerative process in the peripheral nerves and definite involvement of the central nervous system. Bashford recorded profuse hemorrhages in the dorsal cord with interstitial cellularity in the cervical and lumbar regions. The anterior-horn cells were reduced in size and showed definite alterations. In the brain cortex there have been observed round-cell infiltrations around the large motor cells. The pathology is irregularly distributed, but seems to affect symmetrical areas. Bradford states, "the pathology appears to be marked by

degeneration of peripheral nerve fibers at first, and an involvement of the spinal-root ganglia, and spinal cord later."

The infection shows a certain tendency to selectivity for motor-nerve cells and fibers, as the greatest involvement is found in these structures. Most authors believe that the size and length of the seventh nerve make it more vulnerable, thereby accounting for the prominence of this symptom. My own explanation is that the rigid bony canal through which the seventh nerves pass, with the swelling of the nerve trunks, are the causes of the paralysis. In some cases of mild degree the facial nerve is only partially involved or escapes entirely, but in other cases there is a very mild involvement of the extremities, with complete facial diplegia.

Summary. The course of the disease is fairly typical in all cases. In brief, there is an initial illness with perhaps slight fever, followed by an interval in which the patient is not well. Then suddenly pain, followed by generalized muscular weakness or paralysis, begins in the lower extremities, ascends to involve the upper extremities and the face bilaterally. There is a brief febrile disturbance with the onset of pain. The proximal portions of the extremities are more involved than the distal. The acute pain clears up rapidly but motor weakness persists for some time, particularly in the face. Recovery occurs in those cases in which the cranial nerves, other than the seventh pair, escape, or are only moderately involved. No particular remedy has been brought forward for relief of the condition, and Bashford's work on the etiological aspects of the disease need further confirmation.

In conclusion, I believe that acute infectious polyneuritis exists as a distinct clinical entity. It is probable, however, that further study, particularly from the etiological and pathological standpoints, will show its relationship to other forms of multiple neuritis and especially to the condition called infectious neuronitis. Viets, in fact, has suggested the term *polyneuronitis*, rather than polyneuritis, which is certainly more correct from both the clinical and pathological standpoints.

The pain is very largely of the root type in character and distribution, and except for this there is no peripheral sensory-nerve involvement. The motor nerves seem to bear the brunt of the infection, and it is the involvement of the motor cranial nerves in the ascent of the disease that produces a fatal issue, rather than any overwhelming toxemia or infection.

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DISCUSSION

Dr. J. Parsons Schaeffer: I should like to ask Dr. Patton whether he has an explanation for the observation that, of the cranial nerves, the facial is the most vulnerable? The anatomy would lead one to believe that the facial nerve would be involved more frequently than any other cranial nerve, owing to the narrow confines of the relatively long canal through which the nerve passes. I have, therefore, been wondering whether there is a relationship in this connection. In acute swelling of the facial nerve, there would be little room for expansion and the neurons would be under pressure. All other motor cranial nerves pass through short and roomy foramina, and are, therefore, not subjected to the same pressure conditions.

Dr. Patten (closing): In regard to Dr. Schaeffer's remarks I think it is quite possible. We certainly account for paralysis, so-called Bell's palsy, by the acute swelling in the small canal where there is no room for expansion, and that may be a very fair explanation of the situation.

THE RELIEF OF PAIN BY NERVE SECTION*

By FRANCIS C. GRANT, M.D.

(From the Neuro-surgical Clinics of the University of Pennsylvania Hospital and the Post-graduate Hospitals of the University of Pennsylvania.)

The most distressing symptom of any disease is pain. If pain be present it is always the cause of bitter complaint. We can struggle along with disability or deformity provided they are painless, but with the onset of pain we soon plead for relief. And since relief can often be afforded by relatively simple surgical procedures directed against the sensory pathways leading from the areas involved, the sufferer should always be advised that this is possible. He can then decide for himself whether his pain is of sufficient severity to require operative interference.

Since in the clinic with which we are associated the relief of pain in trigeminal neuralgia is frequently practised, we became interested in other conditions causing distress within the sensory distribution of the fifth pair of cranial nerves.[1] Cancer of the face is one of these. Because it primarily attracted attention, and because success here led to similar attempts in other parts of the body, we shall discuss it first.

Malignant disease of whatever type about the cheek, lips, tongue or nasal sinuses is frequently a distressingly painful condition, particularly when far advanced. If to the presence of an open, sloughing, painful sore, producing a filthy breath and foul taste, is added the knowledge that the ulcer is a cancer with meager chances of ultimate recovery, it is not difficult to account for the mental depression in which many of these patients are found. But the most demoralizing factor is the pain—pain from the initial growth, or as a result of excision, electrocoagulation, the implantation of radium needles or deep roentgen-ray therapy. And it is only too often a constant pain day and night, frequently aggravated by the procedures directed against the growth, so that the sufferer dreads to

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return for further treatment. Opiates in rapidly increasing quantities, with all the gastrointestinal and other disturbances which follow their use, are necessary before any reasonable degree of even temporary comfort can be obtained.

This intolerable situation can be relieved by blocking the sensory pathways supplying the face by alcohol injection into or intracranial section of the appropriate branches of the trigeminal nerve. Once the pain has ceased the patient can sleep, eat and carry on his affairs in a much more normal fashion. Treatment is no longer an ordeal. To be sure, the spread of the growth is in no wise affected by blocking the nerve. But it is certain that the gain in weight and strength, the return to a more hopeful outlook on life, freedom from the necessity for opium and a willingness to continue proper treatment, since it is no longer painful, have enabled us to prolong the lives of many patients, in some to effect cures, and in most cases to render the last period of their lives at least less horrible to themselves and their friends.

The method used in relieving pain in the trigeminal distribution depends upon its situation. The more closely the growth and the distress it produces are limited to the trigeminal area, the better will be the result. As can be seen from the table (Table I), a cancer of the floor of the mouth or tonsil has been most difficult to render insensitive, since the cervical and other cranial nerves also supply these regions. Pain in the ear and throat are not affected by trigeminal section. Frequently, these subjects will have a major and a minor pain—the major in the trigeminal area, the minor elsewhere. Abolition of the major pain renders them relatively comfortable for a time, but then the persistence of the minor pain makes it eventually seem as severe as the other and the measure of relief obtained may not be as great as expected. For this reason a close description of the character and position of the pain is important, so that the proper operative procedure may be instituted and the degree of relief to be expected may be estimated.

The trigeminal nerve may be blocked in one of two ways: either by the injection of alcohol into the branch or branches involved, or by open operation with avulsion of the whole sensory root or section of the appropriate division. Injection of alcohol is suitable only for relatively small lesions implicating an area supplied by a single division. Often the malignant growth may have involved the skin where the needle must be inserted to perform the injection, or have

disturbed the anatomical relationship of the nerve so that an accurate infiltration with alcohol cannot be made. However, this procedure frequently appeals to the patient because it does not require ether and seems to the uninitiated a relatively simple thing to do. While the results with it have been satisfactory, open operation is much to be preferred. Intracranial exposure of the trigeminal nerve, with avulsion of the sensory root or section of the second and third divisions, depending on the extent of anesthesia required, is unquestionably the procedure of choice. Since most malignancies causing pain lie in the lower two-thirds of the face, complete avulsion of the sensory root is unnecessary. Section of the nerve trunks peripheral to the ganglion is a simple procedure and precludes the necessity of opening the dura and arachnoid. Furthermore, since the ophthalmic division is spared, eye complications are always avoided.

If the malignant growth is situated superficially within the trigeminal area, the results from nerve-block are very much more satisfactory than when the deeper areas of the face and mouth are involved. When the floor of the mouth, tonsillar pillars or the accessory sinuses, especially the ethmoid or sphenoid, are the site of the lesion, complete permanent freedom from pain is less often obtained. The cancer may spread rapidly outside the zone of anesthesia and, by irritating adjoining nerves, cause in time a recurrence of the distress. Many of the patients sent to us for relief have had all the surgery, radium or roentgen-ray therapy that can be given. Further attempts to control the spread of the disease are considered useless. Morphine has been given in varying amounts to keep them reasonably comfortable. If following nerve section the pain disappears and morphine can be given up, the result is considered successful. If after a time pain outside the trigeminal area recurs but can be controlled easily by morphine until death, we term it a partial success.

Of the 56 patients suffering from cancer of the face, 32 were completely relieved of pain, 14 partly relieved and in 9 nerve-block was ineffective. Among these 9 cases, 4 showed extensive degeneration of the superior maxilla involving the accessory sinuses, while 5 had widespread involvement of the floor of the mouth. In the group completely relieved, 25 died comfortably within two years from metastases, 7 are receiving treatment, of which 2 being apparently cured.

TABLE I.—SHOWING LOCATION OF GROWTH. TYPE OF TREATMENT AND RESULTS. NOTE THAT THE LEAST SATISFACTORY RESULTS WERE OBTAINED WHERE THE FLOOR OF THE MOUTH WAS INVOLVED.

Location of growth.	No. of cases.	Treatment.		Result.
Maxillary antrum and upper jaw	16	Alcohol injection 12	2d division 7 cases	Pain relieved, 3 cases; Pain not relieved, 4 cases.
Pain relieved 11			3d division 2 cases	Pain relieved, 2 cases.
Pain partly relieved 1			2d + 3d division 3 cases	Pain relieved, 2 cases; Pain 50% relieved, 1 case.
Pain not relieved 4		Operation 4	Avulsion sensory root 3 cases	Pain relieved, 3 cases; One death, meningitis.
Died 1			Intracranial neurectomy 2d + 3d division 1 case	Pain relieved, 1 case.
Postethmoid cells and maxillary antrum	1	Operation 1	Avulsion of sensory root 1 case	Pain relieved 60%, 1 case.
Pain partly relieved 1				
Cheek skin	10	Alcohol injection 3	3d division 3 cases	Pain relieved, 2 cases; Pain 50% relieved, 1 case.
Pain relieved 7				
Pain partly relieved 3				
Pain not relieved 0		Operation 7	Avulsion sensory root 2 cases	Pain relieved, 2 cases.
Died 0			Intracranial neurectomy 2d + 3d division 5 cases	Pain relieved, 3 cases; Pain 75% relieved, 2 cases.

Lower jaw	9	Alcohol injection 4	2d + 3d division 2 cases	Pain relieved, 2 cases.
Pain relieved 7			3d division 2 cases	Pain relieved, 1 case; Pain partly relieved, 1 case, Pain in neck remained.
Pain partly relieved 2				
Pain not relieved 0				
Died 0		Operation 5	Avulsion sensory root 1 case	Pain relieved, 1 case.
			Intracranial neurectomy 2d + 3d division 4 cases	Pain relieved, 3 cases; Pain 50% relieved, 1 case.
Tongue	8	Alcohol injection 6	3d division 6 cases	Pain relieved, 4 cases; Pain 50% relieved, 2 cases.
Pain relieved 4				
Pain partly relieved 3		Operation 2	Intracranial neurectomy 2d + 3d division 2 cases	Pain relieved, 1 case, Later spread to neck; Died, shock, 1 case.
Pain not relieved 0				
Died 1				
Tongue and floor of mouth	12	Alcohol injection 10	2d + 3d division 2 cases	Pain not relieved, 2 cases.
Pain relieved 3			3d division 8 cases	Pain 50% relieved, 3 cases; Pain relieved, 3 cases; Pain not relieved, 2 cases.
Pain partly relieved 4				
Pain not relieved 5				
Died 0		Operation 2	Avulsion sensory root 1 case	Pain not relieved, 1 case.
			Intracranial neurectomy 2d + 3d division 1 case	Pain 75% relieved, 1 case.

Based on the experience of the past five years, we feel convinced that the most satisfactory and merciful way to handle a patient with an extensive malignancy of the face which will require wide removal by knife or cautery, the implantation of many radium needles or intensive and deep roentgen-ray therapy is as follows: Even if pain is not a prominent feature, or even if it is absent when the patient is first seen, it is certain that no matter what treatment be instituted pain will sooner or later occur and persist. We suggest, therefore, that the cancer-bearing area and adjacent structures be rendered insensitive before the growth is attacked.

Under morphine-scopolamine-novocain anesthesia the external carotid on the side of the lesion should be tied and the appropriate intracranial procedure carried through. Immediately afterward the growth may be removed or treated in any way desired without pain to the patient. If a cautery knife is to be used, the avoidance of the necessity for the use of ether as an anesthetic simplifies the procedure very much. The occlusion of the external carotid artery is a matter of election. Since it is often necessary to do so before attacking extensive growths, and because it renders the intracranial approach to the nerve entirely bloodless, ligation of the artery has quite frequently been carried out. Following nerve section not only is excision of the growth painless, but subsequent dressings, insertion and removal of packing, loosening of sequestræ or fulguration of areas of possible recurrence in the wound can be conducted without inconvenience to the patient. Any degree of frequency or severity of local treatment aimed at more complete extirpation of the lesion is well tolerated, provided the manipulations are made in the anesthetic area. The difference in appearance between patients who have and who have not had the pain relieved by nerve-block is so striking that, once seen, it makes a lasting impression.

However, satisfactory as this procedure is in carefully selected cases, in certain of them the relief is not complete or permanent. Two complications may occur: the secondary or masked pain covered over originally by the major pain and not situated in the anesthetic area may become annoying, or metastases from the growth may appear in the glands of the neck and cause pain there beneath the angle of the jaw, in the throat or deep in the ear, outside the trigeminal area.

For pain in the neck beneath the angle of the jaw and below the sensory distribution of the trigeminal nerve, laminectomy with sec-

tion of the upper three or four posterior cervical nerve roots is most effective. Rhizotomy of the posterior spinal roots for relief of pain is no new thing, since it was first practised by Abbe[2] at Dana's suggestion in 1895, and again by Chipault[3] in the following year. Fay[4] applied this procedure to the problem of pain in the neck due either to a primary growth involving the glands in this area or, as is more commonly the case, to a metastatic involvement from malignancy of the face. With certain limitations, section of the upper cervical posterior roots affords complete relief. As may be seen from the diagrams, the anesthesia produced extends roughly from the vertex of the scalp down to the level of the clavicle and the spine of the scapula. However, it will not relieve pain deep in the ear or in the throat. High cervical laminectomy is a formidable surgical operation compared to other laminectomies or to avulsion of the sensory branches of the trigeminal. While we have carried through root section a number of times with happy results, it is not clear to us that the simpler procedure of section of the peripheral branches of the cervical nerves where they wind forward over the sternomastoid muscle is not just as effective in producing the necessary anesthesia in many instances. Where the malignancy is extensive, involving the posterior as well as the anterior triangle of the neck, peripheral nerve section cannot be carried out because the incision will pass through cancerous tissue. Under such conditions cervical rhizotomy is indicated. This procedure has been carried out on 5 patients: 2 of these had had the lower divisions of the trigeminal nerves blocked previously with success, but the growth spread into the neck; 4 cases were completely relieved, surviving comfortably for an average of four months; the fifth died free from pain in the hospital two weeks after operation. (Table II.)

It should be reiterated here that neither fifth-root section nor cervical rhizotomy will in any way affect pain deep in the ear or in the throat. The work of Doyle,[5] Adson,[6] Fay[7] and Dandy[8] seems to prove that section of the glossopharyngeal nerve will relieve the pain in the throat. From these reports and from our own limited experience it is evident that intracranial rather than extracranial section of the glossopharyngeal nerve is to be preferred. But glossopharyngeal section does not alleviate the pain deep in the ear; this problem still remains to be solved. We have sectioned the vagus, as suggested by Fay (*loc cit.*), and severed the cervical sympathetic chain extracranially without relief. Pain referred to

the depths of the auditory canal is a common and distressing symptom of cancer of the face and neck. It is the only region which at present cannot be rendered insensitive by nerve section. If we can discover exactly which nerve or nerves to cut, and work out a simple technic for carrying this through, much needless suffering can be avoided.

TABLE II.—RHIZOTOMY

No. of patients.	Roots cut.	Cause.	Result.
5	1–4 cervical	Malignancy, neck	Pain relieved, morphine-free.
1	4 cervical to 4 thoracic	Malignancy, breast	Pain relieved 75%, codeine required.
1	6 cervical to 4 thoracic	Malignancy, axilla	Pain relieved, morphine-free.
1	5 cervical to 1 thoracic	Painful amputation stump	Pain relieved, morphine-free.
1	4–8 thoracic	Tabetic crises	Pain not relieved.
1	9 thoracic to 2 lumbar	Malignancy, groin and penis	Pain 75% relieved, codeine required.
10 pts.			

Complete relief, 7; partial, 2; no 1. No operative deaths in this series. All patients having malignancy died within ten months of operation.

Since we had been successful in relieving the pain accompanying malignant lesions about the face and neck, it seemed logical to attempt the same for painful lesions elsewhere in the body. Problems of this nature were presented by patients suffering from gastric crises and painful amputation stumps, as well as cancer. Two methods of attack are available—posterior rhizotomy and chordotomy, either unilateral or bilateral.

Rhizotomy should be used in relatively localized lesions not involving more than four dermatomeres, and in all instances where the pain field lies above the first thoracic segment. Owing to the overlap between the nerve supply of adjacent sensory segments, it is necessary to destroy the posterior roots running to the areas above and below the region involved. For a lesion causing pain in four dermatomeres, six posterior roots must be sectioned. It is always possible to expose six posterior roots by removing five laminæ, which is about as much surgery as these patients will stand with safety.

Chordotomy, since its original proposal by Spiller and Martin,[9] has proven a very useful, safe and easy method of alleviating intract-

able pain. The reports of Peet[10] and Banzet and Robineau[11] confirm this opinion. Chordotomy is indicated for extensive bilateral or unilateral pain passing over nerve pathways entering the cord below the first thoracic segment. Frazier feels that chordotomy above this segment is unsafe, particularly if bilateral, because of possible involvement of the phrenic distribution. The point of election for severing the anterolateral columns is between the first and fourth thoracic segments. The operation is less serious than rhizotomy, for the removal of but three laminæ is necessary. The actual cutting of the cord can be performed in much less time than is required for rhizotomy, and if Frazier's technic is carefully followed the results are excellent. It is in widespread malignancy of the pelvis with deep-seated pain in this region or in the legs that chorodotomy is especially indicated. We have used this operation in 8 instances: in 4 to relieve pain caused by cancer and in 4 cases of tabetic crises; 6 of these cases were completely relieved. (Table III.)

TABLE III.—CHORDOTOMY

No. of patients.	Level of section.	Cause.	Result.
4*	4 T bilateral	Tabetic crises	4 pain-free.
4†	4 T unilateral	Malignancy	2 pain-free. 1 relieved with recurrence of pain on opposite side. 1 operative death.

* One operative death; one case alive 18 months pain-free; one died 18 months and one in 6 months of intercurrent infection, pain-free.

† Two cases alive and pain-free 18 months and 4 months postoperatively.

These operative procedures for the relief of pain may seem too drastic. Why not give these hopeless cases enough morphine to keep them comfortable and let them die without the discomfort of further surgery? Frankly, this was our attitude before we had the opportunity of comparing patients who had been rendered pain-free with those to whom morphine in increasing amount was being given. Alleviation of pain by morphine is at best only intermittent. In the intervals between hypodermics the distress may be extreme. These operations carry a distinct mortality—rather low, however, when the physical make-up of the patients is considered; but if death occurs, it comes peacefully under an anesthetic without prolonged suffering. Furthermore, in the advanced cases the expectation of life is not long at best. All that we claim for nerve section for the relief of pain is that it is an act of mercy, an alternative to a slow

exitus, drugged by morphine, hoping that death will come speedily. If we realize that relief may be afforded these unfortunates by having them submit to a few days of postoperative discomfort, we can suggest nerve section before their condition becomes too far advanced to preclude any possibility of successful surgery. If they accept it, well and good; if they refuse, we can feel that we have left nothing undone and resort to morphine and other anodynes with a clearer conscience.

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DISCUSSION

Dr. Astley P. C. Ashhurst: I think this is a very interesting and a very important subject which Dr. Grant brings before the College, and that it is worthy of discussion; and though I do not feel myself fitted to discuss it very learnedly, I desire to make a few remarks. As a general surgeon I do not feel myself competent to discuss the special neurological technique of Dr. Grant. At the Episcopal Hospital our neurological surgeon is Dr. Temple Fay, and he has been doing work there similar to that described by Dr. Grant, and has had a very reasonable measure of success in relieving pain in the distribution of the ninth and tenth cranial nerves by cutting

them intracranially, as well as with chordotomies and intradural section of the sensory roots of the spinal cord; and I have myself done some of these operations in years past.

But there are two measures which Dr. Grant has not mentioned which I think can be applied by the general surgeon without special neurosurgical training, which will in most cases afford the patient very great relief from the pain of inoperable tumors, at least for a time, and which are more easily supported by patients with advanced malignant disease than may be these elaborate neurological operations.

One of these measures is *cautery excision* of the growth, or at least of its more accessible portions. Simply decompressing these inoperable tumors by taking off the top of the tumor with the cautery will stop the patient's pain; and this method of cautery excision can be employed even in the presence of infection, which would preclude a clean neurological operation in its immediate neighborhood. It is true that the operation requires a general anesthetic in most cases, and that it may last anywhere from a half hour to an hour and a half, owing to the necessity of discontinuing the ether while the cautery is in use, and then putting the patient under the influence of ether again before resuming the cautery. But the wound which remains is sterile, and being left wide open, is more amenable to roentgentherapy than would have been the original bulky tumor. Indeed some of these wounds left by partial cautery excision of inoperable tumors will heal entirely under roentgentherapy and remain healed for many weeks or months before breaking down again; most of them will heal through a very large portion of their extent, leaving only insignificant ulcers, until the patient finally begins to succumb.

The other measure for the relief of pain in cases of inoperable malignancy, to which I desire to refer, is *paravertebral injections of alcohol* into the nerves supplying the seat of disease. Most of these inoperable painful tumors occur in the neck; and when I talked to Dr. Fay about cervical paravertebral injections of alcohol, he seemed to feel the risk of injuring the vertebral artery was an objection. But I have employed this method in 2 cases without injury to the artery. The first patient, with a large open wound in the side of his neck, secured immediate and complete relief from injection of alcohol into the second and third cervical nerves; but as he had a fatal secondary hemorrhage from ulceration of a large vessel in the open wound within a day or so of my injection, it is not certain that the freedom from pain would have been lasting. The second patient, also with an inoperable and extremely painful tumor in the neck (a metastasis from carcinoma of the larynx), has secured more lasting relief: the paravertebral injection (second and third nerves) was given May 23, 1928, and only a few days ago (June 2, 1928) I was enabled, with a little additional local anesthesia secured by infiltration above the clavicle with novocaine, to excise his tumor (as large as an orange) by means of the cautery. The combined operations have made him very comfortable.[1]

Before concluding, may I ask Dr. Grant if he can suggest any operative

[1] The patient, still free from pain, died in his sleep June 23, 1928, just one month after the alcoholic injection.

method of relieving the pain due to invasion of the vertebral column by malignant disease? Every once in a while such a patient is seen, particularly in cases of carcinoma of the breast. In such cases the vertebral lesion usually is rather high for one to do a chordotomy above it.

As I say, the relief of pain in malignant disease deserves more discussion than I can give it; but I am glad to know that Dr. Grant is continuing his interest in the subject, and in these miserable patients whose remaining days of life may sometimes be made so much less unendurable by the surgeon's skill.

Dr. Grant (closing): I was distinctly interested in Dr. Ashhurst's paravertebral injections of alcohol. That, of course, would be the solution to this difficulty if one could do it. It would save a lot of time and trouble if this could be done. In regard to the time required for these operations I should like to differ. It should not be necessary to take more than an hour and a half to do chordotomy, and possibly it could be done in three-quarters of an hour. If colonic anesthesia or local anesthesia is used, these patients stand the operation extraordinarily well. As regards malignancy involving the vertebra itself, I would suggest that bilateral chordotomy would be the choice. As a matter of fact, I can see no reason why you should not get anesthesia as high as the root of the fifth segment.

SOME KIDNEY COMPLICATIONS OF PREGNANCY*

By JOHN C. HIRST, 2d, A.B., M.D.

In view of recent intense interest in the toxemias of pregnancy, resulting mainly from the glucose treatment of Titus, and in late pregnancy from heparmone or liver-extract injections of Miller, a brief review of the major upper urinary-tract diseases common to pregnant women is presented, to show the importance of such associated urologic complications in the toxemias of pregnancy. These complications may be grouped as follows:

1. Conditions of the kidney, ureter and kidney pelvis, arising mainly from peculiarities of female anatomy.
2. Such conditions resulting largely from pregnancy itself.

The first group includes results of the faulty architecture of the female pelvic organs. Nature provides in a normal woman a poor arrangement of pelvic ligaments and veins, which predispose to ureteral drag and edema on exertion in the upright posture, from sagging of the organs and chronic passive pelvic congestion.

Childbirth may aggravate this by producing cystocele and prolapse, often with infected residual urine and ureteral distortion; and by giving cervical laceration and erosion, with subsequent lymphatic infection spreading outward to contaminate the ureter. Inflammation and adhesions of tube, ovary and pelvic connective tissue prejudice ureteral and kidney health, as evidenced by Outerbridge's report of a case of tubo-ureteral fistula which shows the proximity of these organs. Ovarian cyst and fibroid tumor may lead to hydronephrosis or even suppression of urine, so that all of these conditions peculiar to women may cause kidney disturbance before, during or after pregnancy, not to mention such diseases as ureteral stricture, calculus and neoplasm, which of course, other things being equal, are the same in man or woman.

Group 2 contains complications resulting largely from pregnancy, *per se*. Incarceration of a pregnant retroposed uterus replaced will, if the pregnancy continues, distort or even rupture the bladder or produce suppression of urine by anterior uterine sacculation. Lateral sacculation of the uterus from uterine adhesions (myomectomy) has given gross hematuria from the kidney in two of our

* Read June 6, 1928.

pregnant cases. In later pregnancy, on account of natural right inclination and right torsion of the uterus, aggravated still later by engagement of the fetal head, marked edema (usually of the right ureter), with some compression, may produce more or less back-pressure (hydronephrosis), rendering a fertile soil for growth of the colon bacillus group, especially if constipation be present, or of other bacteria if sinus infection, dental abscesses or septic tonsils be associated; either of which urinary troubles may predispose to excessive vomiting of early, or to toxemia of late pregnancy, as the case may be.

Through the courtesy of Edmund B. Piper, professor of obstetrics, we have charge of the cystoscopic service of the University Hospital maternity, where many toxic as well as urologic pregnant patients are cystoscoped.

There were: From May 1, 1926 to April 30, 1928.

Total deliveries	966
Total abortions	234
Total undelivered women	179
Total pregnancies	1379

This number of pregnant patients showed the following complications:

Total cases of hyperemesis gravidarum		29
Total cases of late gestational toxemia (blood-pressure over 140 systolic)		168
Total cases of appendicitis		2
Total cases of gall-bladder disease		8
Total cases of pyelitis (acute febrile or afebrile with pyuria and symptoms)		68
Right	6	
Left	10	
Bilateral	32	
With hyperemesis	2	
With late toxemia	10	
Bacteriology: Colon-bacillus group	80%	
Total cases of late gestational toxemia with distinct difference in functional test and specific gravity of urine from right and left kidneys, with moderate excess of urine in right kidney pelvis (ureteral edema) out of 6 cases cystoscoped (not included under pyelitis or hydronephrosis)		2
Right		2
Bilateral		6
Total cases of hydronephrosis		8
With hyperemesis		0
With late toxemia		2
Total cases of cystoscopic examination and ureteral catheterization in 1379 pregnancies		23
Total pyelograms		9
Complications from cystoscopy or pyelography (blood chemistry, etc., before and after cystoscopy)		None

Our treatment of simple recent hydronephrosis complicating pregnancy consists mainly in rest in bed with the foot elevated 8 to 10 inches, which is frequently successful, because the etiologic factor is mainly ureteral edema and the renal pelvic distension is slight in comparison with an old hydronephrosis of organic origin (stricture, stone, etc.). The treatment of acute pyelitis consists in similar rest, icebag to side, liquor potassium citrate ½ oz. every four hours, forced fluid with soft diet and laxatives until the temperature falls and symptoms improve. Thereafter, hexamethylenamine, helmitol and hexylresorcinol in succession are given with restricted fluid intake until the urine becomes sterile and pus-free and symptoms diminish. To combat the tendency to persistence in chronic form with remote relapse, to secure complete study and proof of cure and to complete a cure if subacute symptoms persist; cystoscopic investigation and ureteral irrigation with an inlaying catheter are done in many cases, frequently followed by autogenous vaccine therapy. Stricture is *not* commonly found, but evidence of ureteral edema is frequently shown.

The toxemias of pregnancy may be associated with ureteral disease. Pernicious vomiting in early pregnancy frequently accompanies severe pyelitis, and in the late stage after acidosis yields nephritic changes as well as jaundice, as in simple early toxemia. True nonobstructive anuria of pregnancy is a fatal disease, always associated with a dead fetus, and may endure for ten to twenty days and is in no way similar to the usual type of preëclamptic or eclamptic toxemia.

Late gestational toxemia, whether preëclamptic or eclamptic, so-called nephritic or hepatic, sooner or later presents renal degenerative changes. Appearing for the first time, albuminuria, a few casts and only a moderate hypertension may be followed by convulsions, in which case the liver will probably show the main degenerative process, *i. e.*, a hepatic toxemia. A repeat late toxemia in a multiparous woman with prior hypertension, slow development of headache, edema, eye spots and albumen signifies a sure nephritic type. A large percentage of eclamptic cases at autopsy show hydronephrosis, and some of our late toxemic cases at cystoscopy show either pyelitis or hydronephrosis, others show a definite difference in the specific gravity, and functional test of the right and left kidneys, so that we wish to go on record with the statement that prevention of hydronephrosis and pyelitis will reduce the incidence of toxemia,

although in our hands active treatment of these two complications, when existing, has not as yet had much effect on coexisting late gestational toxemia.

For several months we have been treating preëclamptic and eclamptic toxemias with heparmone, a liver extract used first in this connection by Harold Miller, of Pittsburgh, with the following results:

1. The nephritic type gives little or no improvement.

2. The hepatic type may yield a temporary drop of blood-pressure, as much as 100 mm. of Hg. in a few moments. Further injections usually give a sustained reduction of pressure, increase of urinary output and control of convulsions. Twelve cases of eclampsia have recently been treated by heparmone injections without a death, although in several instances glucose administration and other measures were also required. We believe that the usefulness of Heparmone depends upon its blood-pressure reducing ability.

It is gratifying to note that no interruptions of pregnancy have resulted from our cystoscopic efforts. Nor has pyelographic study injured any mother or child. One or two of our toxic patients have developed partial urinary suppression for not over twenty-four hours. Of special importance is the fact that no jaundice or other liver manifestation has followed cystoscopic examination of our toxemic pregnancies. Acute uncomplicated pyelitis has responded splendidly, but chronic pyelitis has only been relieved by prolonged watchfulness, perfect hygiene, and repeated renal lavage, and vaccine injections. Although we have demonstrated that late gestational toxemia is occasionally the result of hydronephrosis or pyelitis, probably secondary to ureteral edema, little improvement in the toxic state during the pregnancy from urologic treatment has resulted when such kidney complication has been of some duration, and associated with organic ureteral or kidney pelvis pathology.

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INVESTIGATIONS CONCERNING THE FUNCTION OF THE PHRENIC NERVES*

By H. A. HARE, M.D.

AND

EDWARD MARTIN, M.D.

For many years it was taught that injury to the phrenic nerves caused death and all the older works on surgery so taught, although Arnold, in 1836, and Valentin, in 1848, proved this to be untrue. The introduction of the operation of phrenicotomy in pulmonary disease, when pulmonary rest is indicated, has led us to make the following report of certain experiments.

Every one knows that respiration, while it is carried on in an identical manner in all warm-blooded animals, so far as certain features are concerned, is of a different character in some points in nearly every variety of animal life, and, furthermore, in many instances is markedly different even in the two sexes. Thus, the respiration of the human being is carried on not only by the diaphragm, but also by the intercostal muscles and those large bundles of muscle which are so plentifully distributed over the chest wall. It is also well recognized that the movement of the diaphragm and the thoracic respiratory muscles are in unison, and that each one aids the other by increased action whenever necessity arises. That respiration may, however, be carried on sufficiently well to support life even though these two sets of muscular fibers do not act *together* has been proved by such well-known investigators as Mosso,[1] who found that the want of agreement between the movements of respiration may become so great that the diaphragm and thorax move in opposite directions at the same moment. This, for example, occurs sometimes during the sleep produced by large doses of chloral, both in man and the lower animals. Again, it is perfectly possible in some animals to inhibit the action of the diaphragm or thorax completely without producing very marked or, indeed, any notice-

* Read October 3, 1928.

[1] Archivio per le scienza Mediche, 1878.

able change in the general system, either because the action of one is so imperfect that its loss is scarcely felt, or because one portion is enabled by increased action to make compensation for the inactivity of the other part. A very familiar example of this is seen in everyday life, when some abnormal growth in the abdomen presses upon the diaphragm in such a way as to prevent it from carrying on its functions, and under these circumstances the chest muscles become accustomed to bear a greater strain and to supplement the diaphragm. Contrawise, growths in the chest, or chronic diseases of the lungs, frequently lead to the total abolition of chest movement and enormous increase in diaphragmatic functional activity. In the human race we have, perhaps, in a better way than occurs in any of the domestic animals, an example of the variation which sex brings about in the respiratory function. Thus, as we all know, the diaphragm plays a far more important part in respiration in the male than in the female, so that while in man the chest movement is at a minimum and the abdominal movement at a maximum, in the average woman this state of things is directly reversed, for obvious and physiological reasons. In the woman far advanced in pregnancy the upward displacement of the intestines against the diaphragm impedes its movements very greatly, and if the natural breathing of the female sex was not so largely thoracic, even greater dyspnea would come on in pregnancy, particularly in its advanced stages, than we are accustomed to see. This form of thoracic respiration is the explanation of the survival of tight corsets in the average woman, and it is the abdominal breathing of the male which makes any similar constriction absolutely unbearable and suffocating. Again, in the female, ascites and all dropsical affections of the abdominal cavity are less frequently associated with dyspnea than are similar affections in man. Even the enormous ovarian tumors sometimes seen are not accompanied by the dyspnea one would expect, for the double reason that the thorax moves more easily, and becomes more rapidly accustomed to compensatory action than does the thorax of the male.

From what we have just said, it is evident that woman can physiologically survive injuries affecting the movements of the diaphragm much more readily than can man, and we think that this should be considered as an important factor when making a prognosis as to the ultimate result of any such traumatism.

Those who are cognizant of the teaching of physiologists concerning phrenic nerves will remember that the chief function of these nerves is to innervate the diaphragm, and that, if these nerves are cut or their function is in any way ablated, the diaphragm becomes but a relaxed and flabby sheet of muscle which is pulled hither and thither as the atmospheric pressure is altered by the movements of the thorax. They will also remember that, according to the most generally received teachings of the past, such a condition has been generally conceded as fatal in man and in most of the lower animals, but we have conclusively proved that this idea is not only fallacious in man, but that it also is *particularly untrue* even in those animals in which respiration *depends entirely,* during ordinary life, upon the *diaphragmatic* movements. Recent resort to phrenicotomy in human beings confirms this view. Thus in the rabbit of full growth it will be seen that the chest walls move not at all, unless under increased respiratory action, yet we have found, and our results are confirmed by Marckwald,[1] that section of the phrenic nerves in these animals, provided they are over four months of age, is not necessarily followed by death, and is never so followed provided the animal is allowed to assume a position in which the full play of the chest muscles may be brought about. It is evident, therefore, that in the human being whose respiratory movements are largely thoracic there is far less increase in the action of the chest muscles in order that respiration may be carried on after paralysis of the phrenics than in an animal whose normal breathing is never thoracic, but diaphragmatic. Consequently, logical reasoning of necessity brings us to the conclusion that injuries producing this lesion should not be fatal in man provided certain precautions are followed.

Although, as has already been stated, all our teachings at one time were that such a condition ends fatally, there are records given us by capable observers proving that a fatal result is not inevitable. Thus, Duchenne observed cases in which complete paralysis and atrophy of the diaphragm existed to such a degree that, during inspiration, the epigastrium and hypochondrium fell in, while the thorax expanded, the opposite movements occurring during expiration. The patients "appear to aspirate their abdominal viscera by dilating their thorax during inspiration." This same observer states

[1] Studies on Respiration, Kreuznach, 1888.

that he has seen this condition in those suffering from hysteria, progressive muscular atrophy and chronic lead poisoning, and that he is cognizant of cases in which this condition persisted for years.

That man should, theoretically, suffer less from diaphragmatic palsy than the rabbit is supported, therefore, both by clinical evidence and also by experiments which we have recently performed, the results of which form part of this paper.

We have found that in some of the higher animals, whose breathing is largely thoracic, no untoward effects follow phrenic section, and Panizza has done likewise; thus, in the dog, while paralysis of the diaphragm produces instantly very noticeable changes in the respiratory movements, it cannot be said that any signs of asphyxia develop, simply because the thoracic muscles instantly increase their functional activity. That this increase in activity is real is proved by the fact that if the animal be killed several weeks later, the muscles of the chest are found greatly hypertrophied and the antero-posterior and lateral diameters of the thorax are greatly increased. At the same time it is to be noted that the diaphragm has undergone very marked degeneration and atrophy as a result of its lack of nerve supply and functional activity. A very typical instance showing this result can be obtained in the animal in which the phrenic nerve has been cut on one side only, as under these circumstances the half of the diaphragm on the injured side may, in the course of two weeks, be found thin and membranous, while the opposite side not only preserves its normal thickness, but is generally better developed than before.

We have performed bilateral phrenic section in the rabbit, the dog, the goat, the horse and the monkey. In order that no more pain might be given than was necessary, and chiefly to avoid a reopening of the wound for antiseptic reasons, we made section of these nerves, not by the scissors or knife, but by a sudden, quick jerk of the hitherto slack ligature passed behind the nerve. If the jerk be instantaneous and forcible, a fine, strong ligature cuts its way through with less pain to the animal than would be imagined, and while, at the first glance, it would seem as if one could not tell that the nerves were completely severed by such means unless the wound was opened, yet the mere fact that a loop comes away perfectly intact, and often with a small quantity of nervous matter adhering to it, proves that the nerve has been completely divided.

Experiments to Show Effect of Phrenic Section in Normal Animals and to Show Value of Abdominal Support in Such Cases

Experiment No. 1.—Rabbit, buck; weight, 1½ kilos; full grown.

4.30 p.m.: The phrenic nerves have had a ligature passed around them without the use of anything more than a slight whiff of ether. In order that the animal may be as nearly as possible in its normal state when the phrenic nerves are severed, twenty-four hours will be allowed to elapse before these nerves are severed.

Next Day. 5.45. p.m.: Phrenic nerves divided. There is no struggling for breath, and the respirations are not greatly altered, except in so far as the movements of the diaphragm and abdominal walls are concerned. The animal remains very quiet, and, if undisturbed, fails to exhibit marked evidences of dyspnea. It is to be noted that the number of respiratory movements, with abdominal support made by the application of the hands to the animal's sides and the under surface of the belly, are 72 per minute, while without support they are 78. The changes are so slight in this animal that we are inclined to believe that sufficient irritation of the phrenics has been produced during the twenty-four hours succeeding the operation to have caused the rabbit to breathe more with its chest, and so to have at least partially prepared itself for its new respiratory action. That this is more than mere supposition is proved by the position of the ligatures when taken away, for they were found to be matted together on both sides and shrunk by the juices of the parts. Indeed, it is possible that the nerves were considerably compressed by this means.

Eighteenth Day: Animal alive and well. The excursion of the ribs at the level of the sixth rib is 9 cm.; at level of the floating ribs it is 3 cm.; midway between the belly and the ribs it is 2 cm. The increased costal movement is, therefore, very marked.

Experiment No. 2.—Rabbit, gray buck; weight, 2 kilos.

3 p.m.: Nerves taken up on ligatures.

5.50 p.m.: Both nerves severed. As no ether was administered, it was thought unnecessary to allow a greater elapse of time before the completion of the operation; there is no evidence of dyspnea. The respirations are not stormy and the general appearance is not one indicating systemic disturbance. The diaphragm can be seen to descend very markedly on expiration and to ascend on inspiration.

6 P.M.: The animal has remained stationary since the last observation, apparently from a fear that the dyspnea, which is not pressing while it is quiet, may increase on exertion. It is evident that there is really no lack of air in the lungs.

6.05 P.M.: Pressure on the belly slows the respirations and gives the animal entire relief, so that, forgetting its dyspnea, it attempts to move about. The number of respirations are only 60 per minute when compression is used, but are 90 per minute when no pressure is applied.

6.30 P.M.: The respirations are now 120 per minute, owing to a rapid run around the room, when no pressure is applied; but pressure relieves the dyspnea and the respirations immediately drop to 84 per minute.

Nineteenth Day: Alive and well.

Fifty-sixth Day: Alive and well.

Sixty-fourth Day: Killed. The diaphragm was found to be very much degenerated, being a mere transparent tissue-paper-like membrane, while the thoracic capacity was remarkably increased. The pectoral and intercostal muscles were much hypertrophied.

EXPERIMENT No. 3.—Rabbit, doe; weight, 2 kilos; full grown.

2.10 P.M.: No anesthetic used. Phrenics have had ligatures around them for twenty-four hours. She has, today, a breathing closely resembling that seen in the rabbit whose phrenic nerves have been already cut, and there is probably irritation of the nerves produced by the ligatures. The respirations at this time (before section), without support, are 70 per minute; with support, 60 per minute. When the animal is placed on its back, between the knees of the experimenter, there is evident dyspnea and the respirations rise to 95.

2.30 P.M.: Phrenics are cut. The respirations are now 108 without abdominal support, and only 78 per minute with support.

2.40 P.M.: Respirations are now 94 without support, and 66 per minute with support. The animal has been very quiet since the last observation, which probably accounts for the less rapid breathing.

2.48 P.M.: Respirations without support are now 108 per minute, owing to a run; with support they are 78 per minute.

Eighth Day: Alive and well.

Sixtieth Day: Alive and well.

Sixty-first Day: Killed.

The phrenic nerves on both sides were found to be cleanly and

completely divided. The chest capacity was enormously increased. The thorax was most unlike that usually found in rabbits. In shape and muscular development it was strikingly similar to that of the dog. The diaphragm was practically converted to a fibrous membrane. The muscular portion was thin and atrophied, was easily torn by the nail, and, when held to the light, exhibited to the unaided eye many patches of complete degeneration.

Experiment No. 4.—Rabbit; weight, 1 kilo; aged three months. No anesthetic used.

2 p.m.: Ligatures have no sooner been placed around the phrenics than evidences of dyspnea present themselves, so it would appear that these nerves have been irritated or injured. The animal throws itself on its belly, on the table where it has been set free, as soon as possible.

2.40 p.m.: Phrenic section has been made without waiting for several hours to elapse. The dyspnea is now very marked and there is slight humping up of the back with each respiration. The forefeet are braced as if for support. The respirations without support are 48 per minute; with support they are only 30. Abdominal support gives marked relief to the dyspnea if applied properly. The counts of the respirations were made so frequently that there can be no doubt of their accuracy, nor of the value of the abdominal support in producing relief; thus when the support was given by means of a binder, on its removal dyspnea increased instantly, and death occurred from asphyxia twenty-five minutes after the section of the phrenics.

Experiment No. 5.—Rabbit; weight, 1 kilo; aged three months.

2.30 p.m.: The phrenic nerves have just been taken up on ligatures and the wound closed.

4.04 p.m.: The respirations are at this time 60 per minute.

4.05 p.m.: The phrenics are now divided by jerking the ligatures.

4.06 p.m.: Respirations are now 96 without support to the belly, but are 60 with support applied by the hands. Binder was applied and allowed to remain.

4.36 p.m.: The respirations are stilll at 60 per minute.

4.45 p.m.: Dyspnea is evidently increasing.

4.50 p.m.: Death from asphyxia.

Remarks. It is evident that in the young rabbits the death is due to exhaustion of the thoracic muscles, and that as long as these

functionally remain intact, life is preserved. It is also evident that belly support did good in every instance in which it was applied.

We have already spoken of the violent struggles which ensue when the phrenic nerves are divided, and it has been thought by Marckwald and others that the sensory fibers, discovered by Budge and Panizza, were the transmitters of a sufficient degree of pain to make it probable that this was the cause of the struggling movements. In our opinion, however, this is in part a mistaken idea, since we have found that rapid section of these nerves in older rabbits, when in a normal posture, is not followed by these struggles, and this observation has also been found to be correct in respect to the dog and goat. As the nerves are severed in both instances the cause of the struggles must be the asphyxia which ensues when the animal is tied down on its back. The presence of sensory fibers, however, has been frequently brought to our notice by the fact that violent struggles may take place when these nerves are picked up and irritated. This was especially marked in the horse.

As we have established the fact that section of both phrenics is, if the animal is tied on its back, fatal, it has seemed to us not only interesting, but of value practically, to determine the effect of section of one phrenic at a time. One animal was full grown, but another was young and poorly developed. In the first, death did not follow; in the second, death did ensue. In another instance the rabbit was also a young one, and death again took place. The thought occurred that the exposure of the nerve and the necessary irritation of it might sufficiently interfere with its function to be a cause of death. The result was interesting, for the rabbit lived and suffered no inconvenience. It may, therefore, be considered proved that, while single phrenic section is not fatal in old rabbits, in young ones it is often so, but that the danger is much less if the nerve on one side is left absolutely untouched by the operator.

The general appearance of an animal, notably the rabbit, after section of the phrenic nerves must be considered according to the position in which the animal is placed. The nerves are so superficial in the rabbit that we found that the creatures suffered not at all if no anesthetic was employed, and as a consequence the animal was at no time unconscious. If both these nerves be cut simultaneously, or within a few moments of one another, while the rabbit is *tied upon his back*, death comes very rapidly, for a convulsive movement sweeps over the body and is immediately replaced by the peculiar out-

stretching of the extremities, which is so commonly the immediate precursor of death. On the other hand, if the animal is immediately set free, so that it can assume its normal posture, the respirations are exceedingly hurried and temporarily imperfect, but are sufficient, nevertheless, to support life, provided the thoracic muscles and the chest walls are sufficiently well developed to act with a reasonable amount of power. That this is true is proved by the fact that if a rabbit not yet full-grown is operated upon, death ensues more or less rapidly according to the state of development of the thoracic muscles, and it would seem to be simply a condition in which the question arises as to whether these muscles are able to bear fatigue or not; for, in the rabbit of two months, death ensues after the lapse of but a few minutes, although at first there was not apparently much dyspnea, while in the rabbit of three or four months the same results may obtain after a greater length of time. Thus we have known a rabbit about three-quarters grown to live for three hours and then die, very evidently owing to the fact that the muscles of the chest could not sustain the suddenly increased labor required of them. The older rabbit learns thoracic respiration, and after the lapse of a few days presents no evidence of respiratory disturbance, save that the movements of the chest walls are increased and those of the abdomen reversed.

We also found that it was necessary for cerebration to be undisturbed by hypnotics or anesthetics, as under these circumstances the animal realizes its condition and uses voluntary effort in breathing, as well as the impulses sent out by the respiratory center. Thus, in an instance where ether was employed in a full-grown and well-developed rabbit, and the phrenics divided before complete control of equilibrium and mental cleaness had returned, death occurred with great rapidity entirely from asphyxia.

The question immediately arises as to what is the cause of the relief which ensues upon the animal being removed from the position of dorsal decubitus to that ordinarily assumed, and we think that the explanation is not far to seek. If one recalls the position of the abdominal contents in the rabbit in respect to that of the chest, he will remember at once that here, as in all herbivora, the contents of the former are not only of large bulk, but of a very movable character. In the animal stretched upon its back, the abdominal viscera flatten out, distending the abdominal walls laterally to a considerable extent, and at the same time relieve the diaphragm of the pressure

which they ordinarily exert upon it. As a consequence, no sooner is this muscle paralyzed than it flaps to and fro, being drawn up into the thorax as the ribs expand, and being driven into the abdomen as they contract; the result of this is that a large quantity of residual air, far above the amount normally present, remains in the chest, and fresh air necessarily is constantly decreased in the lungs. If, on the other hand, the animal is in its normal position, the abdominal viscera (being supported by the thick and powerful thighs laterally and the strong recti muscles anteriorly) are necessarily held in such a position that they prevent the diaphragm from making a very wide excursion. It is easier, under these circumstances, for the ribs when they extend to draw in air than to draw up the diaphragm with its load of abdominal contents behind it, and conversely, on expiration the chest may drive out the impure air with less effort than is required to force down the diaphragm and to displace the stomach and intestines. That this is true we have proved by direct experiment, examples of which can be given. It was noted, too, that if a rabbit had an empty belly, from hunger, it was more strongly dyspneic after diaphragmatic palsy than one which had just taken a full meal of bulky food. Again it was found repeatedly that such a rabbit is relieved if bilateral and upward pressure on the abdomen is exercised by the hands of the experimenter, or if a bandage is carefully applied with the same purpose in view, namely, to give the diaphragm direct support.

It is necessary, in the application of this pressure, to limit it to the abdominal wall low down, in order to avoid confining the action of the floating ribs; this is most easily done by the hands, but a bandage can be used if care is exercised in its adjustment. But even yet the *raison d'être* of all these changes is not entirely embodied in what we have said. Haller has found that if the contents of the abdomen are removed from a living animal, every time the diaphragm contracts the ribs are drawn inward owing to the manner in which this muscle is attached laterally. In the normal animal, however, the abdominal viscera are fitted up against the diaphragm and are displaced laterally and downward when inspiration occurs. The result of the lateral displacement is that the floating ribs are supported and are not drawn inward, as in the animal with its abdominal viscera ablated or as in the rabbit whose intestines are displaced by the assumption of an abnormal posture. If any one will place a rabbit in the position of dorsal decubitus, he will see how

the entire abdominal mass moves away from the diaphragm and fails to support it. In this position the walls are prevented from remaining rigid or from being forced outward as the diaphragm pushes the contents of the belly against it, and this being the case, neither the thorax nor the diaphragm can be used to advantage for the maintenance of life.

The presence of the abdominal viscera is, therefore, necessary for the normal action of the diaphragm.

If the animal be allowed to become quite hungry several days after section of the phrenic nerves, the skin covering the flanks flaps to and fro with a movement directly opposite to that of the ribs, or, in other words, moves as does the paralyzed diaphragm.

The practical bearing of this is, that the ordinary directions for the resuscitation of those who have ceased breathing, generally from apparent drowning, are radically wrong, since the placing of a large bundle of clothes under the back, while it elevates these parts, slides the abdominal viscera downward and at once places the ribs and diaphragm at a serious disadvantage.

For the reasons just given the goat does not suffer so severely as the rabbit upon phrenic section.

Experiment No. 11.—Female goat; weight, 25 kilos.

3.15 p.m.: Normal respirations, 60.

3.20 p.m.: Section of phrenics.

3.21 p.m.: Chest walls move now, but did not do so before the section. Respirations are 62. Diaphragm descends with expiration, and this becomes still more marked if the goat is driven around the room rapidly. There is no dyspnea.

Five days later there is no change to be noted save that the costal movements are more full than before. Eight days after the operation escaped from the room and was lost.

Experiment No. 12.—Female goat (kid); weight, 15 kilos.

Has been very unruly and has struggled violently. After the phrenics were exposed they were stimulated; by mistake, the current used was exceedingly strong and produced evidences of pain. Immediately after this, asphyxia came on and the animal was removed from the trough, in which it was tied, with all speed.

Artificial respiration was maintained as well as it could be by compressing the ribs, but with no appreciable effect. Oxygen was now employed and with signal benefit.

As soon as voluntary breathing was renewed it was noted that the

right side, which had been stimulated by the unusually strong current, was paralyzed and moved as if the diaphragm had been paralyzed by section of the phrenic nerve. Later this passed off, showing that it was due to the effect of the battery.

In this experiment the dorsal position would have been, if continued, necessarily fatal, owing to the distended belly pressing on the diaphragm and so laming the chest, for it is to be remembered that the walls of the abdomen in the goat are much more tense than in the rabbit, so that while in the one the pressure is too little, in the other it is too great.

3.30 P.M.: Has recovered completely.

3.34 P.M.: Phrenics cut.

3.35 P.M.: Respirations are largely costal and are exceedingly rapid, 130. The diaphragm descends with expiration.

3.36 P.M.: Respirations are now 150. There are no signs of dyspnea.

Although the goat, like the rabbit, breathes almost entirely by the diaphragm, except on extra effort, the physical arrangements of the chest and abdomen are somewhat different. Of course, both animals belong to the class known as herbivora, and in consequence are possessed of long alimentary canals which require and take up a great amount of space. In addition to this, however, the alimentary canal of both these animals is generally in the condition of hyperdistention, owing to the large quantity of food which they ingest. In the goat, however, this distention is more marked than in the rabbit, and in addition, the position of the body is entirely changed; for in the rabbit the hind-quarters are very near the ground, whereas in the goat they are higher than the level of the fore-shoulder. The tendency, therefore, of the abdominal contents in the rabbit is to press moderately on the diaphragm, whereas in the goat a large part of these organs is thrown against this muscle by reason of the length of the hind-legs. The result of this is that the goat is more frequently called upon to resort to thoracic respiration owing to the diaphragm being partially incapacitated, and is consequently less affected when a call is made for increased thoracic movement upon paralysis of the diaphragm. In the horse, phrenic section is accompanied by even less disturbance than is seen in the goat and dog, and the reason for this is but a continuation of our already expressed line of thought. Every one who watches a horse breathe

must see that its normal respiration is more thoracic than abdominal, and, indeed, the abdominal movement is not only limited but frequently is irregular or ceases altogether. It is because the extra strain on the thorax is scarcely noticed that diaphragmatic palsy is so slight an accident to this quadruped.

EXPERIMENT No. 13.—Horse, full grown.

3 P.M.: Respirations are now 12 per minute. When the phrenics were exposed and handled signs of pain were manifested.

3.05 P.M.: Right phrenic cut. Respirations are now 18.

3.30 P.M.: Left phrenic cut.

3.35 P.M.: Respirations are now 24 per minute. There is no apparent discomfort, but the respirations are now solely costal, the belly movements being reversed.

Day After the Operation: Perfectly well.

Next Day: Still apparently perfectly well.

Section of the phrenic nerves in the dog produces symptoms no greater than in the horse and for the same reasons. The dog breathes largely by the thorax at all times, so that diaphragmatic palsy influences it not at all so far as the eye can perceive.

EXPERIMENT No. 14.—Dog; weight, 6 kilos.

2 P.M.: Ligatures passed around both phrenics and the wound dressed.

4.15 P.M.: Both phrenics severed. The respirations are not much, if at all, disturbed.

In order to be sure that the nerves prepared were the phrenics, they were galvanized before section and produced spasm of the diaphragm. The belly goes in on inspiration instead of out, as in the normal animal. The rapidity of the respirations is not perceptibly increased, but the ribs move much more extensively.

Third Day: Had secondary hemorrhage and was pithed. Dissection showed that phrenics were completely severed.

This experiment shows very clearly that in those animals where respiration is largely carried on by the thorax, section of the phrenic nerves is not followed by so much disturbance as in the rabbit, for example, whose respirations are entirely diaphragmatic.

EXPERIMENT No. 16.—Monkey, small but full-grown; in perfect health.

2 P.M.: Phrenic nerves exposed, the operation lasting half an hour.

3 P.M.: Phrenic nerves divided, no discomfort resulted. Belly movement reversed from the normal as in all other animals under the same circumstances.

3.30 P.M.: Monkey is still a little intoxicated from ether, but it is quite strong and belligerent.

Next Day: Perfectly well. Eats well and moves as does the normal monkey. Belly movement is as markedly reversed as yesterday. Chest movement is more extensive.

Third Day: As well as ever. He remained so for weeks.

CONCLUSIONS. We conclude, therefore, that section of one or both phrenic nerves is not necessarily fatal in animals if the thoracic muscles can carry on respiration.

That when the phrenic nerves are inadvertently cut, or deliberately cut, the patient should not be anesthetized, or, if under an anesthetic, it should be withdrawn and oxygen and CO_2 freely used, because the volume of respired air is decreased after phrenic paralysis until the thorax compensates for the loss of the diaphragm.

That in a patient with a relaxed belly wall phrenicotomy is more dangerous than in a patient with a normal belly wall.

That section of the phrenics is more dangerous in the patient with obesity than in the lean, and that in the very young disphragmatic paralysis is more dangerous than in the well-developed adult. Further, in those who have a rigid chest wall it is dangerous, and particularly in emphysema, in which case the respirations are largely disphragmatic.

That in instances of phrenic injury support should be given the belly walls to prevent their movement and to brace and steady the paralyzed diaphragm, care being taken that the floating ribs are free and that the body should not be kept or placed so that the belly contents fall away from the diaphragm. In the obese, however, the Trendelenburg position is unwise in that it interferes with lower costal movement.

The matter of normal diaphragmatic movement is of importance in the localization of severe injuries to the cervical spine, for if the lesion be below the level of the third cervical vertebra, from which level the phrenics arise, the movements of the diaphragm will be normal and it may be that life will be maintained solely by this type of inspiration.

Last, we have shown that any attempt to increase respiration by faradizing the phrenics in the course of surgical anesthesia, results in

cardiac arrest by stimulating the vagi and thereby causing cardiac arrest. While, from the standpoint of the physiologist, stimulation of the vagi can arrest the heart only temporarily in the presence of an operative crisis, such temporary arrest may be an important factor in causing a fatal result.

DISCUSSION

Dr. Edward Martin: Just one point bearing on this work. In deaths from anesthesia, fortunately more rare than they were in former days, we noticed, this being one of the things that led to our investigation, that from the respiratory standpoint the first muscle to be paralyzed was the diaphragm, characterized by a reverse of normal-breathing belly motion. During inspiration the belly would be sucked in and during expiration thrust out, incident to the diaphragm having become a soft, flapping partition. Thereafter, the chest muscles ceased to act, and the violent effort on the part of the neck muscles expressed the final effort of the failing respiratory center.

Dr. J. Earl Thomas: I would add an incidental observation to that of Dr. Hare that the dog is especially resistant to asphyxia following paralysis of both phrenic nerves. In certain experiments on dogs it happened that movements of the diaphragm interfered with some of the experimental procedures and, rather timidly at first, I cut both phrenic nerves. Though the animals were anesthetized, also in the dorsal position, they showed no particular sign of asphyxia or distress during the course of the experiment. I was interested, too, from the physiological standpoint, in the apparent ability of the diaphragm to resist fatigue as compared with the other muscles of the thorax. The question often comes up in physiology as to how it is possible for the diaphragm to continue its activity throughout life without fatigue. Perhaps this muscle is provided with some special adaptation which renders it more resistant to fatigue than other muscles of the body.

INFECTION AS A CAUSE OF JUVENILE CIRRHOSIS*

By V. H. MOON

(From the Department of Pathology of Jefferson Medical College.)

Cirrhosis has no definite age period of occurrence; cases occurring in infants are not rare. Mackay[11] reports a case beginning in a babe aged eleven days and ending fatally twenty-seven days later. Abt[2] records a case beginning at two weeks of age and progressing to a fatal termination five months later. Postmortem examination confirmed the diagnosis in each case. It appears that cirrhosis in the newborn is rare, and that the frequency of occurrence increases with age. Seitz,[14] summarizing 320 cases, found 31 among sucklings, 72 in young children and 217 in children of school age. Among these were occasional instances in which several children in the same family died of cirrhosis.

Cirrhosis occurring in the young presents certain important differences from that seen in adults. Marked enlargement of the spleen is an early and almost constant feature. I have collected data from several hundred reported cases: marked splenic enlargement has been an associated feature in more than 90 per cent. The spleen is often of huge dimensions, approximating those found in leukemia. Concurrent with the enlargement of spleen and liver, anemia of gradual onset is usual. Cirrhosis in children occurs in the same general forms as in adults, but cirrhosis of the biliary type occurs more frequently than in adults. The occurrence of intermediate or mixed forms is very frequent. This discussion will be limited to those forms, often designated as hypertrophic and atrophic, which are analogous to the portal cirrhosis of adults. It is understood that the term hypertrophic is often assigned because of the increased size of the liver. Such increase in size is a regular feature of the early stages of the process which ends in the typical "hob-nailed liver" of atrophic or portal cirrhosis. This form of

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enlarged liver occurs very frequently in children, and the designation hypertrophic cirrhosis does not necessarily imply a different form of disease. Cirrhosis in children is more acute and runs a more rapid course than in adults.

Many pathologists[17] discuss cirrhosis as chronic hepatitis. This conception contributes to a clearer understanding of the process, since hepatitis implies inflammation reaction to injury, which may be the result of diverse causes. Hepatitis properly includes the cellular degeneration and fatty changes, resulting in increased size of the organ—hypertrophy—in the early stages. It includes the cellular destruction and the resulting active proliferation of both liver cells and bile ducts. It includes the infiltration with inflammatory cells, and the reparative proliferation of fibrous tissue, the contraction of which results in the decreased size—atrophy—of the later stages.

The assembled evidence indicates that juvenile and adult cirrhosis do not differ in etiology. In case reports of juvenile cirrhosis the causative agents most frequently assigned are alcohol, vaguely defined intoxications, congenital anomalies and infections.

If alcohol were the chief primary cause the condition should occur in a much higher percentage among those addicted to its use than among nonusers. A drug capable of producing such change should have a demonstrable toxicologic action, as do mercuric chlorid, phosphorus, chloroform, or other drugs whose effects can be shown readily by experiments on animals. Cirrhosis has not followed the use of alcohol experimentally. This fact, together with the frequent occurrence of cirrhosis in those having no alcoholic history and its relative infrequent occurrence in alcoholic habitues, indicates the importance of other factors than alcohol. Adami[3] commented on the failure of alcohol to produce characteristic cirrhosis in animals, and stated that "Extreme cirrhosis may attack children and adults who have never taken a particle of alcohol either medicinally or otherwise." Excessive use of alcohol produces fatty infiltration of the liver in man and in animals. In this connection the experiments of Opie[15] are significant. He was able to produce cirrhosis in animals by first causing degeneration of the liver by the administration of chloroform, then inoculating living bacteria intravenously. Streptococci were used in some of his experiments; in others Bacillus coli was used. He believed the chloroform acted to lower the resistance of the liver, rendering it subject to the infection. He suggested

the possibility that alcohol may play a rôle similar to that of chloroform in these experiments. The combined action of two factors, as lowered local resistance resulting from injury by alcohol, chloroform or other agents, plus bacterial infection, has received less attention than it seems to merit.

Space does not permit a review of the evidence on toxic cirrhosis. Its importance is generally recognized and has been substantiated by experiments on animals. A number of injurious substances, quite diverse in character, have been used to produce cirrhosis more or less closely resembling that occurring in man.

That congenital abnormalities may occasionally be of such kind as to result in cirrhosis is admitted. There is evidence that this cause is frequently assigned when cirrhosis of unknown origin would be a proper diagnosis. Cirrhosis due to congenital abnormalities is seldom verified by postmortem examination.

Infection is frequently mentioned among etiologic factors. In his summary of 320 cases Seitz stated that about 33 per cent were of infectious origin. Supporting this view is the frequent occurrence of fever, malaise, nausea, rapid pulse and other evidences of infection. Leukocytosis is present in a considerable proportion of cases. When the leukocytes are not increased a leukopenia is usually present. The splenic enlargement and anemia which mark the early stages of cirrhosis could be produced by a chronic infection as readily as by toxic agents. The histologic alterations present resemble those of a chronic infection. The leukocytic infiltration and the active reparative processes seen in rapidly developing cirrhosis are typically the reaction called forth by chronic infection. Syphilis, kala azar and other tropical infections may produce cirrhotic changes indistinguishable from the type under discussion. The demonstration of the parasites in the liver substance in these diseases is accepted as evidence of the causative agent. That other infections than those mentioned may produce a similar result is probable.

Bingel[5] made examinations of the livers in fatal cases of scarlet fever. In each case he noted extreme degeneration and necrosis of the liver cells and inflammatory infiltration about the vessels. In the liver of a case in which death followed a protracted attack of scarlet fever he found those same changes present, but in addition there was the rapidly proliferating fibrous tissue which characterizes early cirrhosis. He regarded the fibrous proliferation as an

attempt to repair the injury resulting from the infection. Several writers comment on the occurrence of cirrhosis following scarlet fever and measles.

In a case reported by Mya[13] cirrhosis developed during the course of a prolonged enteritis. At postmortem examination chronic ulcerative enteritis was found, and cirrhosis of atrophic type. Others comment on the development of cirrhosis during the course of chronic infections, such as bronchitis, pleuritis, meningitis, arthritis and endocarditis. Edwards,[7] in a review of 100 cases, found an active associated infection in 25 per cent of them.

Bolton[6] reported a case of cirrhosis in a child in which the postmortem examination showed a purulent peritonitis without apparent cause. He believed the cirrhosis was produced by infection of the liver, which finally spread to the peritoneal surfaces. In cases of cirrhosis an associated pleuritis, pericarditis or peritonitis is often found at postmortem and the occurrence of inflammatory adhesions about the liver and spleen is particularly frequent. These suggest infection rather than intoxication, with chemical or metabolic products.

Levi,[10] in 1898, reported a case in which cirrhosis was concurrent with mitral endocarditis in a boy, aged seventeen years. He cultivated from the liver a diplococcus which was pathogenic to guinea-pigs.

Adami[3] investigated an epidemic disease of cattle of which cirrhosis, resembling that occurring in man, was the prominent pathologic feature. He found minute coccoid bacilli in the livers in great numbers. When cultivated, this organism resembled somewhat the bacillus of hemorrhagic septicemia. When injected into rabbits the infection localized in the liver, producing degeneration and necrosis of liver cells. The rabbits died before cirrhotic changes had time to develop. Having established the infectious nature of cirrhosis in cattle, Adami and Abbott[1] used the same methods in human cases. By special staining methods they demonstrated great numbers of organisms in the livers of 5 human cases and cultivated the organism in 4 cases. This organism was very minute, ovoid or coccoid in shape and grew in long chains. It manifested a confusing pleomorphism, but was identified as a strain of Bacillus coli by Adami's coworkers. On the strength of these findings, cirrhosis is discussed as an example of the mechanism called subinfection in Adami's volume, *General Pathology*.

Mallory[12] examined for bacteria the livers from 2 cases of juvenile cirrhosis and found slender bacilli, possibly Bacillus coli, in 1 of them. No cultures were made. He believed these cases were of infectious origin.

Baginsky[4] cultivated a streptococcus from the heart blood and from substance obtained by puncture of a cirrhotic liver in 1 case.

Folger,[8] in 1 case, found streptococci in the liver; no cultures were made.

Weaver[16] produced cirrhosis in guinea-pigs by injecting Bacillus coli into the portal circulation. Hektoen[9] reported similar experiments.

Notwithstanding the accumulated evidence suggesting infection as a cause, a thorough bacteriologic study of cirrhosis has not been made. The instances are rare in which bacteriologic examinations of any kind are recorded in either clinical or postmortem reports. The author is attempting such a study, and the following results are of the nature of a preliminary report:

Case I.—The patient, a girl, aged twelve years, had no significant history except the indefinite mention of childhood diseases. Her symptoms were weakness, nosebleed and vomiting of blood. The skin was icteric, and the spleen greatly enlarged. Blood examination showed hemoglobin, 35 per cent; red cells, 3,500,000; white cells, 18,000, of which 60 per cent were polymorphonuclear and 40 per cent lymphocytes. Death occurred twenty-four hours following admission. The provisional diagnosis was Banti's disease.

Postmortem examination (Dr. B. L. Crawford) showed a spleen which was rough and fibrous and had irregular thickening of the capsule. The follicles could not be seen. The spleen weighed 930 gm. (Fig. 1). The liver was pale, shrunken, irregular, hard and nodular. Bands of fibrous tissue surrounded islands of liver cells. It weighed 980 gm. There was no ascites. Chronic hyperplasia of the spleen and chronic atrophic cirrhosis were the chief gross pathologic conditions.

On microscopic examination the liver presented the usual picture characteristic of atrophic cirrhosis. The spleen was fibrotic; the pulp and follicles showed a decrease in cellular elements.

Sections of liver and spleen were stained by the Gram-Weigert (Figs. 7 and 8) method for demonstrating bacteria. Both the liver and spleen contained large numbers of cocci occurring in pairs, short chains and irregular groups. The postmortem examination had been done too long before for cultures to be of value. Cultures for bacteria were not made in this case.

Case II.—A white boy, Joseph S., aged fourteen years, was rather small for his age. He was one of a family of 14, 8 of whom were living. One

sister died of atrophic cirrhosis at the age of thirteen years with clinical features similar to those presented in this case. Some weeks subsequent to Joseph's death his brother, aged twelve years, was brought to the hospital with a greatly enlarged abdomen and essentially the same clinical features as Joseph had shown. His parents removed him from the hospital before clinical studies were completed. Joseph had had diphtheria, but the parents gave no account of other infection. The younger brother was stated to have had scarlatina. The use of alcohol was denied both by the boy and the parents.

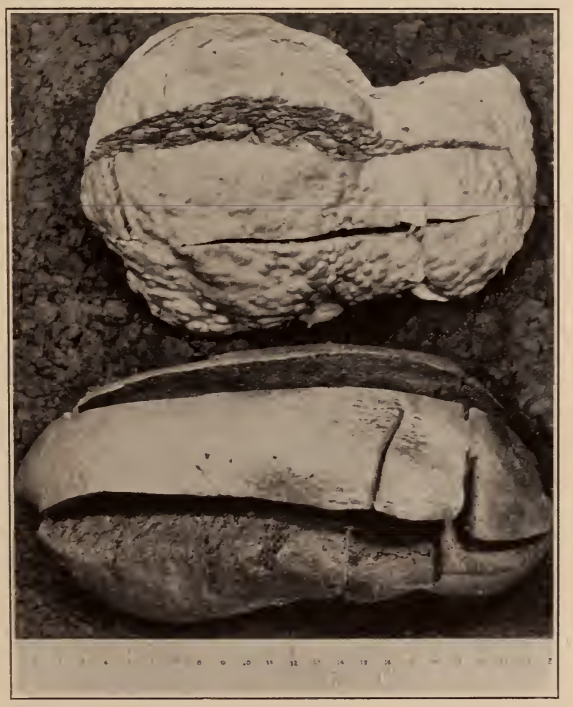

FIG. 1.—Case I. Juvenile cirrhosis, photograph of liver and spleen.

The condition began insidiously with no pain nor distinct malaise. Lassitude and swelling of the abdomen were first noted. Examination showed a greatly distended abdomen. The liver and spleen were greatly enlarged. No ascites was present on admission, but developed in large quantities later. The hemoglobin was 47 per cent, the red cells 2,700,000 and the leukocytes 2600. There was no history nor evidence of syphilis. Blood Wassermann test was negative for each of the parents. The patient's blood was anticomplementary. The temperature ranged from 97.6° to 100° F.; on one occasion it rose to 102.4° F. The urine was concentrated and dark in color. Otherwise no abnormal urinary findings were noted. Slight icterus devel-

oped shortly before death. There was a slight tendency to bleed from insignificant injuries, but no spontaneous hemorrhages. The course was progressive, ending in death ten weeks after the abdominal swelling first developed. No clinical diagnosis was made.

Postmortem examination (Dr. B. L. Crawford) showed slight icterus of the skin, prominence of superficial veins, distended abdomen and edema of the scrotum and legs. There was an excess of clear fluid in the pericardial,

Fig. 2.—Case II. Juvenile cirrhosis, photograph of liver and spleen.

pleural and peritoneal cavities. The lungs were congested and showed early bronchopneumonia. The lymph nodes near the hilus of the liver and pancreas were about 2 cm. in diameter. They were soft and had a grayish-red color. The kidneys were slightly swollen and were pale.

The spleen weighed 1120 gm. It was smooth, firm and deep red, slightly mottled. It did not bleed when cut. Microscopically there was almost total absence of cells in the splenic pulp and of lymphocytes in the follicles. There was slight proliferation of fibrous tissue. The splenic sinuses were

FIG. 3.—Case II. Liver, low magnification. Shows perilobular distribution of mature fibrous tissue. New fibrous tissue invading lobules where destruction of liver cells has occurred, as at *A*.

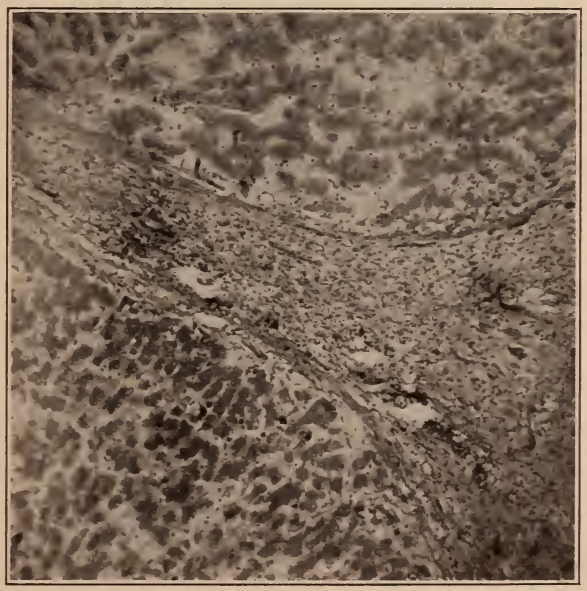

FIG. 4.—Case II. Liver, medium magnification.

distended with blood and there was widespread recent necrosis of the cells of the splenic pulp.

The liver weighed 1330 gm. It was uniformly enlarged, pale yellow in color and the surfaces were roughened and nodular, giving it a typical "hob-nailed" appearance. The nodules varied from 2 mm. to 1 cm. in diameter. The liver was hard and cut with marked resistance. The cut surfaces showed a marked proliferation of connective tissue surrounding small yellowish nodules of liver substance. Microscopic examination showed a marked cirrhosis, which differed from atrophic cirrhosis as seen in adults, only in that the process seemed more recent and more active than that usually seen in adult cases. Three processes marked the condition: Degeneration, necrosis and disintegration of liver cells; proliferation of liver cells and of bile ducts; abundant widespread proliferation of fibrous tissue, perilobular in distribution, but invading the lobules, where necrosis of liver cells was most marked. There was a moderate cellular infiltration, consisting mostly of lymphoid cells together with a small percentage of polymorphonuclear cells. These features strongly suggest a chronic infectious process, in which the inflammatory reaction shows proliferative rather than exudative features.

This case presented suitable opportunity for bacteriologic study postmortem. A small bit of liver was excised aseptically. Scrapings from it were streaked on blood-agar, suspended in columns of melted agar and planted in broth. After twenty-four hours' incubation there were hundreds of minute, grayish colonies on the blood-agar plates. Each colony was surrounded by a wide zone of hemolysis. No other type of colony was present. The columns of agar contained very numerous, small, grayish colonies throughout. The broth cultures were uniformly slightly turbid. Microscopic examination of each of these showed streptococci in perfectly pure culture. No other organism grew in any of the cultures.

Paraffin sections of the liver, stained by Gram-Weigert's (Fig. 5) method, showed numbers of cocci occurring in pairs, short chains and irregular clumps. The liver cells containing these cocci showed advanced degeneration, many were necrotic and were undergoing disintegration. This condition was found diffusely throughout all parts of the liver. Sections of the spleen, stained by Gram-Weigert's (Fig. 6) method, showed likewise great numbers of streptococci, the distribution of which was not so diffuse, but rather tended to localization in small clumps. No bacilli nor other organisms were found in these sections.

It seems improbable that the streptococci found in the liver and spleen were the result of postmortem contamination for the following reasons:

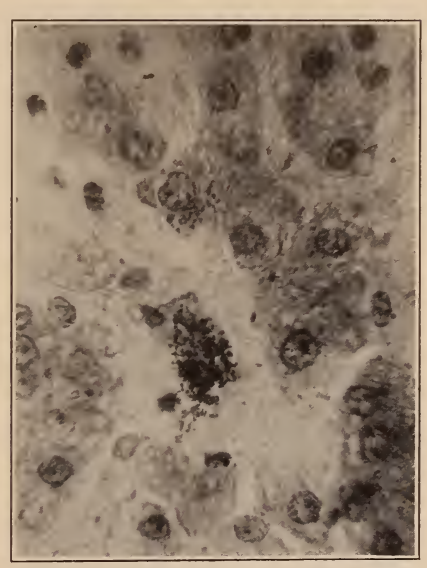

FIG. 5.—Case II. Liver, Gram-Weigert stain, high magnification. Degenerated and necrotic liver cells. Scattered cocci and a large cluster in a group of necrotic liver cells.

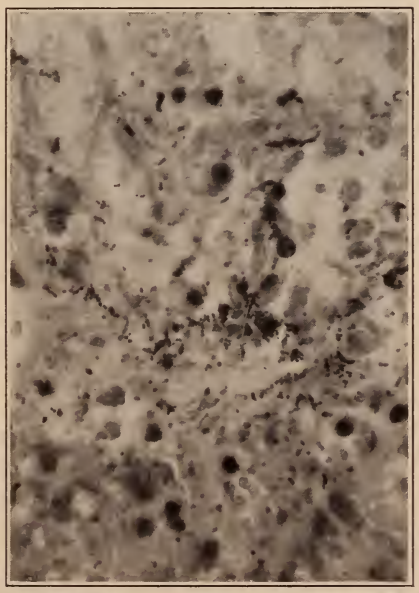

FIG. 6.—Case II. Spleen, Gram-Weigert stain, high magnification. Splenic cells mostly degenerated or necrotic; engorgement of blood spaces; numerous cocci.

Their presence in numbers was accompanied by necrosis of liver cells and more active cellular response than where the cocci were not so numerous. This would indicate their presence during life.

The streptococci were cultivated in pure culture and in large numbers. A postmortem invasion of the liver would probably have consisted of motile bacilli from the bowel tract. Such organisms appear earliest as postmortem contaminants.

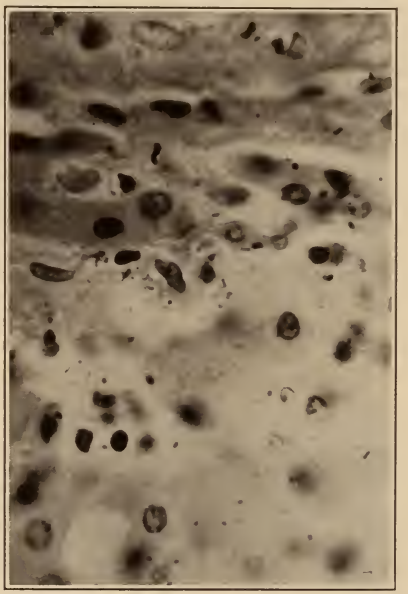

FIG. 7.—Case I. Liver, Gram-Weigert stain, high magnification. Degeneration and necrosis of liver cells; numerous scattered cocci.

The streptococci were found equally numerous in sections from the upper surface of the right lobe, the central portion and the portion adjacent to the colon. Postmortem spread of organisms would be most numerous adjacent to the bowels.

No organisms were found in sections of the kidney cortex, although sections taken from the anterior surfaces were examined. A postmortem spread of bacteria should involve the anterior portions of the kidney at least as early as it would the entire substance of the liver and spleen.

Cultures of the heart's blood taken at autopsy remained sterile. This would be unlikely if either postmortem contamination or

terminal septicemia were the occasion for the widespread distribution of streptococci in the liver and spleen.

Rabbits were inoculated immediately with the hemolytic streptococcus cultivated from the liver. Some received intraperitoneal injections of the centrifugalized sediment from broth cultures; others received similar sediment intravenously. In others sediment containing streptococci was mixed with melted agar and injected subcutaneously. The latter method was designed to produce a

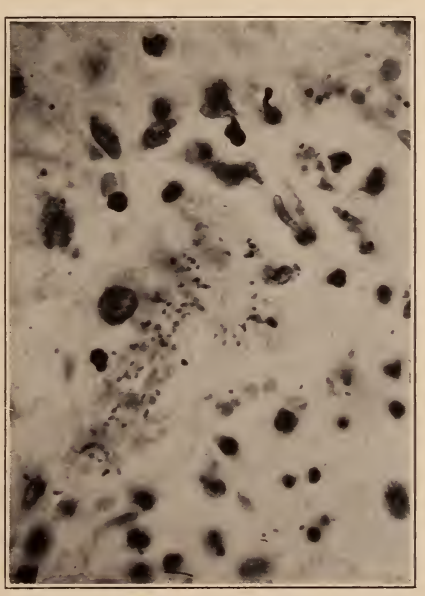

FIG. 8.—Case I. Spleen, Gram-Weigert stain, high magnification. Degeneration of splenic cells, fibrosis, engorgement, numerous cocci.

slower absorption of the bacteria into the animal's circulation. It was an attempt to produce a chronic focus of infection from which invasion of the system might take place continuously.

The histories of the first 4 were given in detail. The remaining 8 had exactly similar features following the inoculation, except that in 3 there was an intercurrent infection of rabbit pneumonia, which was a factor in causing the death.

Rabbit No. 1, received 2 cc. of broth, very rich in bacteria, intraperitoneally. He became sick, ate very little, lost flesh and died four days after the inoculation. Postmortem examination was made within thirty minutes of

death. The muscular tissues were pale; the liver much enlarged and very dark red; the gall-bladder greatly distended. The kidneys, spleen, adrenals, heart, lungs and joints appeared normal. Tissue or fluid from each of these areas was cultured. A pure culture of hemolytic streptococcus was obtained from the heart's blood and from the spleen and liver. Cultures made from the kidney, bile, muscle, joint fluid and peritoneal washings remained sterile.

Rabbit No. 2, inoculated subcutaneously with streptococci in agar, developed redness and swelling at the site of inoculation. Two days later he seemed slightly sick, slightly inactive, but continued to eat normally. Five days after inoculation he was again apparently normal and remained so until the eighth day, when he was killed and examined. There was a localized abscess 1 cm. in diameter at the site of inoculation. The liver was very large and dark red. The other organs and tissues appeared normal. Cultures were made as in Rabbit No. 1. The streptococcus was recovered from the liver and from the subcutaneous abscess. It was not present in the cultures from the other sites. (See Fig. 9 for condition of liver.)

Rabbit No. 3, inoculated by subcutaneous injection of agar behaved similar to Rabbit No. 2 and was apparently normal six days after the inoculation. He died and was examined ten days after inoculation. There was a subcutaneous abscess about 1.5 cm. in diameter at the site of the agar injection. The liver was dark red but not enlarged. The pericardium was distended with about 5 cc. of clear fluid. The peritoneum contained about 15 cc. of clear fluid. Cultures were made as before. The streptococcus was recovered in pure culture from the liver, the pericardial fluid and from the site of the agar injection. It did not appear in cultures from other sites.

Rabbit No. 4, was injected intraperitoneally with about 4 cc. of the original broth culture from the boy's liver. He was distinctly sick for several days but gradually recovered. Seven days later he was apparently normal except for lameness in the left leg, the knee-joint of which was swollen and tender. Two weeks after inoculation he was killed and examined. The peritoneum showed no evidence of inflammation. The liver was very large and dark red. A local abscess was present in the mediastinum and the left knee was swollen and contained purulent material. All other structures appeared normal. Streptococci were recovered from the liver, mediastinal abscess and joint. Cultures from other sources including the peritoneum showed no growth.

The details and results of the experiment on rabbits are given in tabular form for the sake of brevity.

It will be seen from an inspection of the tabulated results from this group of rabbits that in 11 of the 12 animals the inoculated organism was recovered from the liver. Rabbit No. S5 died at night and examination was made a number of hours later. Postmortem contamination of the organs in this rabbit made it impossible

to determine accurately the presence or absence of the inoculated organism. Infection of the liver in these rabbits occurred regardless of the route or site of the inoculation. It was found also in the spleen in 5 of the rabbits. This may be significant in view of the fact that juvenile cirrhosis appears to be a splenohepatic disease rather than purely hepatic. Streptococci were demonstrated microscopically in the spleens of the human cases studied.

RESULTS OF ANIMAL INOCULATIONS.

Rabbit.	Inoculation.	Termination.	Days.	Streptococcus recovered by culture from:					
				Liver.	Spleen.	Kidneys.	Blood.	Peritoneum.	Other sites.
S 1 . .	Peritoneal	Streptococcus infection	3	+	+	−	+	−	−
S 2 . .	Agar, subcutaneous	Killed	6	+	−	−	−	−	Subcutaneous abscess.
S 3 . .	Agar, subcutaneous	Streptococcus infection	10	+	−	−	−	−	Pericardium.
S 4 . .	Peritoneal	Killed	13	+	−	−	−	−	Mediastinal abscesses; joint.
S 5 . .	Peritoneal	Epidemic pneumonia	20	±	±	±	±	±	±
S 6 . .	Peritoneal	Streptococcus infection	2	+	+	−	−	+	−
S 7 . .	Intravenous	Epidemic pneumonia	15	+	−	−	−	−	−
S 8 . .	Intravenous	Epidemic pneumonia	10	+	−	−	−	−	Pericardium.
S 9 . .	Intravenous	Streptococcus infection	5	+	+	−	+	−	Gall-bladder.
S10 . .	Intravenous	Killed	6	+	+	+	+	−	−
S11 . .	Intravenous	Killed	6	+	−	−	−	−	−
S12 . .	Agar, peritoneal	Streptococcus infection	4	+	+	−	−	+	Mediastinum; lung; pericardium.

EXPLANATION: Under the termination "killed" the rabbit was always first anesthetized. The symbols + and − indicate the presence or absence of the organism in cultures from the organ. The symbol ± indicates indeterminate result.

The fact that generalized infection and death did not occur regularly even when large numbers of streptococci were injected intravenously indicates that the virulence of this particular strain was low. Such a strain is well adapted to produce chronic infections.

None of the rabbits in this experiment were allowed to live long enough for cirrhotic changes to occur. Experiments are being continued under conditions suitable to determine the effects of chronic infections with this streptococcus. Such results as may be obtained will be the subject of a later report.

Sections from livers of the rabbits showed extreme degeneration and destruction of liver cells. In many cases the cells were far advanced toward dissolution and no cells of normal appearance were to be found. Sections stained by Gram-Weigart's method showed very numerous cocci (Fig. 9). In some these were diffusely distributed throughout the sections; in others there was some tendency to localization.

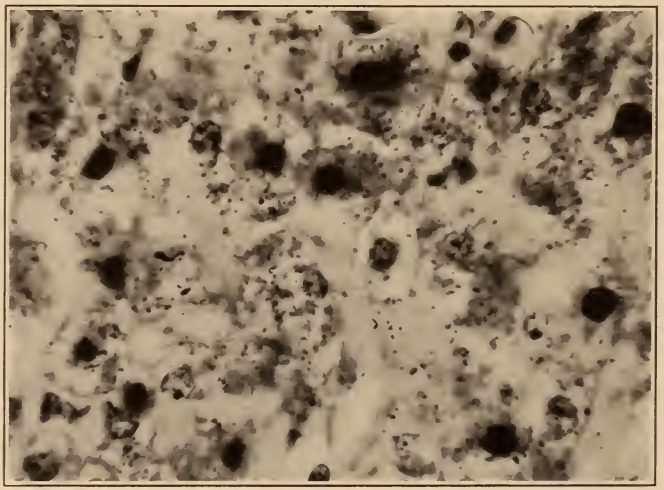

FIG. 9.—Liver of rabbit, killed seven days after a subcutaneous inoculation with hemolytic streptococcus, mixed with soft agar. This specimen was in fixative within five minutes after the rabbit was killed. Gram-Weigert stain, high magnification. Destruction of liver cells, congestion, numerous cocci.

A remarkable feature was the deficiency of inflammatory response to the infection. Leukocytes were absent, or very few were present, even in areas where injury to the liver cells was extreme and where many cocci could be seen.

CONCLUSIONS. Evidence from collected cases indicates that juvenile cirrhosis is a combined disease of liver and spleen.

The presence of streptococci in the liver and spleen was deter-

mined in 2 cases of atrophic cirrhosis occurring in children of school age.

The streptococci cultivated from the liver of 1 case showed a definite tendency to infect the liver in animals.

The histologic changes present in cirrhotic livers are such as would result from a diffuse infection of long duration.

Chronic infection of the liver should be regarded among the important causes of cirrhosis.

NOTE.—The author acknowledges indebtedness to the Medical Staff of Jefferson Hospital and to Dr. Crawford, pathologist, for their hearty coöperation in this study.

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THE INTRAVENOUS USE OF DISTILLED WATER*

By THEODORE LeBOUTILLIER, M.D.

In taking up the discussion of the distilled-water treatment from its clinical aspects it will be wise to consider the direct action which it exerts on the blood.

Much experimental work has been done since Müller, in 1829, described hemolysis which took place when distilled water was brought in contact with frog's blood. Recent investigations have confirmed his findings where massive doses have been used, and further, that death occurs only when 275 cc. of distilled water per kilo of body weight were used (Stenga, 1924–1925).

Schatz, in his paper read before the American Therapeutic Society in 1927, confirms, by experimental work on rabbits, this statement: that it takes, for the most part, 275 cc. of distilled water per kilo of body weight, given intravenously, to cause death.

These statements are given here to refute at once the assertion of some physicians that the use of distilled water is a dangerous procedure and quite possible to cause death.

Distilled water as we use it, given in doses of from 1 to 5 cc. intravenously, has never been known to cause harm. It has been proven that immediately following its injection hemolysis takes place, so rapidly in fact that it has been practically impossible to see the cells in the process of destruction; but red coloring matter is clearly demonstrable in the blood serum after standing for hours, while this is not evident in ordinary blood serum.

It has been demonstrated that there is an average increase of over 100,000 red cells within twenty-four hours of the injection, with no appreciable change taking place in the white blood cells, in number, size or type. Further, that the coagulation time of the human blood is decreased in direct proportion to its normal time of coagulability; that is to say, if it takes ten minutes to coagulate, after an injection of distilled water, the clot will form within six minutes; while if it coagulates within three minutes, the time will be decreased not over half a minute. This proves clearly that fibrinogen

* Read, October 3, 1928.

has been liberated from the red corpuscles, or in other words, that hemolysis has taken place. A further proof is that the hemoglobin is increased from 2 to 4 per cent following the injection.

Distilled water acts in a way similar to nonspecific proteins, by increasing antibody production, but unlike them distilled water does not cause severe fibrile reactions. The only reactions obtained are an increase of the symptoms of the disease or condition for which it is given when too large a dose is administered. We have never seen such reactions as fever, redness, pain or swelling over the site of injection, as is commonly seen when nonspecific proteins are used. If distilled water is given intramuscularly there is intense pain at the site injected, which lasts for from five to ten minutes, or until the water has been absorbed.

Distilled water should never be given until a careful study has been made of the case; any foci of infection found and, when possible, removed or treated.

We have found that many diseases are benefited by this treatment when the origin has been bacterial, allergic or even metabolic, both in acute and chronic conditions, but that most favorable results are obtained when deep-seated organic lesions are slight or when the process is a nonvirulent one, with the exception of the pneumonias, which, treated in the early stage, give results that have been uniformally good. Indifferent and negative results are to be expected when marked destructive lesions are present or when the condition is a virulent one, as in advanced pulmonary tuberculosis.

We do not claim for this therapeutic procedure that it is beneficial in every condition or that the results are uniformally good, but we do claim that in the vast majority of cases upon which it has been used the results have been so much better than when other methods of treatment solely have been employed; hence we feel it should be brought to the attention of the medical profession. Further, we do not attempt to make use of this treatment without the aid of such drugs, vaccines or other means as have been found of benefit in the diseases and conditions treated, but only use the distilled water as an adjunct, for we find that by so doing much more rapid and successful results are obtained.

The method of administration is that of an intravenous treatment, except that we have found that a small blood-pressure band makes the most convenient form of tourniquet, as there is not the possibility of disengaging the needle from the vein when the pressure is relieved.

The water should be triple distilled; only to protect from any poison going over in the first or second distillation. It is placed in sealed ampoules or puncturable, rubber-stoppered, 10-cc. vials, which are then autoclaved. Unless the glass container is non-soluable it is better to use freshly prepared solution, *i. e.*, within three days of distillation. Surgical asepsis at the site of the injection is of course necessary.

The amount of water used for various diseases and patients varies from ½ to 5 cc., and in the determination of the amount useful for a given case lies one of the most important factors of this treatment. Ordinarilly from birth to six years the dose should be from ½ to 1 cc.; from six to twelve, from 1 to 1½ cc.; twenty to fifty, 1½ to 5 cc.; while after fifty the dose should be decreased. Another important factor is weight, height and general condition; the dose to be gauged according to the individual.

The rate of flow into the vein is important, as we have found that better results follow when one minute is taken to inject 1½ cc. than when the same quantity is injected in half a minute. In other words, the water comes in contact with a greater number of red cells and a greater amount of hemolysis takes place when given slowly.

The size of the first dose should be the minimum one for the case in hand. Each succeeding dose may be increased by ½ cc. until the maximum is reached or decided improvement has been obtained, when succeeding doses should remain the same.

In acute conditions small doses at more frequent intervals will be found to have a better effect than a large dose less frequently given, *i. e.*, a 1-cc. dose repeated in from forty-eight to seventy-two hours will be better than a 3-cc. dose repeated in seven days.

For subacute or chronic conditions the reverse holds: It is better to give a large dose every seven to fourteen days than numerous small doses. As soon as improvement takes place the length of time between doses should be increased and the patient instructed to return only when there seems to be a slight retrogression.

Continued use of the distilled-water method with the proper study of the dosage and frequency of administration are necessary to produce the best results. Experience is the best teacher.

It is with hesitancy that I name the diseases of the respiratory tract first among those where benefit occurs, but so startling have been the results obtained that they deserve first place.

Cases of grippe or influenza will be practically cured in twenty-

four hours if seen and treated within twenty-four hours of the start, which is three times as rapid a cure as by any other means that I know of. The very best results occur when a dose of a vaccine is given intramuscularly at the same time.

Lobar- and bronchopneumonia yield more rapidly to this treatment when combined with a vaccine than when a vaccine is used alone. In 29 cases treated during the last four years we have not had a death. Four cases of lobar pneumonia, 2 adults and 2 children, had the crisis on the fifth day of the disease; 3 of the cases received only two treatments of distilled water each, the other case two treatments of distilled water and two of vaccine. Of the 25 cases of bronchopneumonia, all children, about half had only distilled water, while the others had both distilled water and vaccine; 7 of them recovered in twenty-four hours after the injection was given; fortunately 5 of them were seen in consultation and the diagnosis made before I saw them, so that there was no possibility of overenthusiastic error on my part.

A most interesting case:

D. S., aged six years. Bronchopneumonia started during the night of May 7, 1928. Fever, delirium, rapid respiration, with small area of impaired resonance and bronchial breathing at right apex, anterior next evening; 1 cc. distilled water and $\frac{1}{3}$ cc. vaccine were given. The following evening the right apex was practically cleared up, with a small area of impaired resonance and bronchial breathing at left base, posterior. Temperature went up to 105°. Gave 1 cc. distilled water and $\frac{2}{3}$ cc. vaccine. The next night the temperature ran up to 106°; the area at left base cleared up, leaving an area of dulness at left apex, anterior. On May 13 the left apex showed mucous râles and the temperature dropped to 100°. On May 18 he complained of pain in left axillary region and back at base, with slight pleuric friction rub. Gave 1 cc. distilled water and $\frac{1}{3}$ cc. vaccine. On May 20 he was much better; temperature was down to 99°, and from then on he made an uneventful recovery. There were three distinct areas of infection, followed by pleurisy at the left base, which all gave signs of resolution twenty-four hours after the use of distilled water and vaccine.

Acute neuritis in all its forms yields rapidly to this method; in fact, if seen within two days of the start, one injection will as a rule cure the condition within twenty-four hours. Chronic forms will take three to five treatments for a cure to be procured.

Mrs. B., aged fifty-seven years. June 30, 1928. Tic-douloureux, right side, for seven years off and on. Has been carefully studied. Sinuses,

teeth and tonsils negative or operated on without relief; had been given two injections of alcohol into the nerve unsuccessfully. On June 30 1 cc. distilled water relieved the pain within twenty-four hours and she was feeling much stronger. On July 4 a second treatment of 1 cc. was given, and the third treatment one week later. She has had no pain since the first treatment and is in better physical condition than for many months.

Mr. D., aged fifty-two years, seen on February 6, 1928. Neuritis in right shoulder and down arm to elbow for three weeks. History of football injury to right shoulder twenty-five years ago. Has had no neuritis before; teeth, tonsils and sinuses in normal condition. Gave ½ cc. distilled water at 1 P.M., and at 6 P.M. the pain had entirely disappeared. There has been no return of pain up to the present time.

Miss L., aged thirty-nine years, seen January 8, 1928. For eight years severe pain back of neck, involving cervical region, during the past year; intercostal nerve also involved and brachial plexus to elbow. Teeth were normal and tonsils had been removed November 9, 1927, since which the pain has been much more acute. Gave 1 cc. distilled water, and for three days there was complete absence of pain followed by a slight increase. On January 15 gave 1½ cc., which was followed by only slight pain. This treatment continued until February 10, when she strained herself by carrying a heavy bag. Gave 1½ cc., which gave marked improvement, which has continued.

Mr. G., aged fifty-seven years, seen March 31, 1928. Complained of pain in right shoulder for three days; pain on motion and on pressure over nerve. No history of previous attacks; general condition always good; teeth, sinuses and tonsils in normal condition. Gave 1½ cc. distilled water. Pain relieved in twenty-four hours.

Miss G., aged fifty-three years, seen October 8, 1927. Case of intercostal neuralgia, left side, second and third ribs; normal in every other way. Gave 1½ cc. distilled water, with relief in twenty-four hours.

Miss L. E., aged twenty-one years, seen September 28, 1927. Pain in lower lumbar region of about two months' duration; examination showed normal condition elsewhere; no history of previous attacks. 1 cc. distilled water given, with relief of pain in thirty hours.

Mrs. G., aged forty-two years, seen March 10, 1928. Complained of lumbago, both slides; duration, twenty-four hours; history of no other attacks; teeth, sinuses and tonsils normal. Gave 1½ cc. distilled water with relief within twelve hours.

Mr. C., aged seventy-six years, seen April 7, 1927. For three weeks has had severe pain over sacrolumbar region, right side, just below crest of

ilium; teeth normal; tonsils removed; sinuses negative. $\frac{4}{5}$ cc. given, with absolute cessation of pain in twenty-four hours. On April 12 was given 1 cc. distilled water, and at the end of the month went fishing, getting wet up to the waist, not changing clothes until night, but had no return of pain. Normal ever since.

Mr. S., aged forty years, seen September 13, 1927. Severe left sciatica following an automobile accident; exceedingly nervous and much depressed; in every other respect normal. 1 cc. distilled water given. Reported on September 20; pain very much less; could stand with comfort; still slight pain when walking. Gave $1\frac{1}{2}$ cc. distilled water, with complete relief of pain.

Mr. P., aged fifty-three years, seen April 27, 1928. Had had two previous attacks of arthritis; first, following injury of left knee in 1923, at which time he was laid up for twelve weeks; second attack in 1925, when for twenty-four weeks unable to get about. Present attack commenced eighteen days ago in left elbow, both knees and feet; some swelling of feet with redness; also swelling of elbow; general condition is very good; no teeth, tonsil or sinus trouble. Gave 1 cc. distilled water, followed by slight relief. On March 1 2 cc. distilled water were given with distinct improvement. Arm could be moved in any direction with more motion in shoulder; feet distinctly better. On March 16 almost free from pain; after exertion, slight soreness in right knee. Gave 3 cc. distilled water, and on March 28 had entirely recovered.

Mr. K., aged twenty-eight years, seen May 22, 1928. Pain in right knee, foot and hand, occasionally going to left side; started three weeks before, following attack of tonsillitis; tonsils excavated and contained pus; ordered removal. Gave $1\frac{1}{2}$ cc. distilled water. He was given weekly treatments of 2 cc. distilled water until the last treatment, July 2, when he had entirely recovered, but still retained his tonsils. Six treatments in all were given.

Mrs. M., aged fifty-three years, seen May 24, 1928. Interesting case of chronic arthritis. Five years ago swelling of fingers, gradually spreading to all joints. For the last ten months has been unable to use hands on account of stiffness and pain, which has extended to knees and hips. She had been unable to stand or straighten legs and remained in wheel-chair. Had decayed teeth with pus at roots, which were ordered extracted. This was done between the second and third treatments without increase of pain. After the fourth treatment she was able to stand with aid and walked a short distance. For six weeks during the summer there was no treatment and stiffness recurred, but since September 1 she has improved much and is able to stand with less assistance than formerly.

Mrs. B., aged thirty-three years, seen May 2, 1928. Three weeks before attack of acute rheumatism involving knees, elbows and hands; slight swelling, no redness; teeth are bad; tonsils normal. Gave $1\frac{1}{2}$ cc. distilled

water with distinct improvement, less pain and less swelling. 2 cc. were then given and the pain disappeared in two days.

For urticaria we find that distilled water cures much more rapidly than any other treatment:

Mrs. B., aged fifty-two years, May 25, 1928. Had had urticaria of exceptionally severe type for several years; had taken every form of treatment without results; food protein reactions had been negative; tonsils had been removed and teeth *x*-rayed; had always sensation of nausea before attack. 1 cc. distilled water gave marked improvement; second treatment a week later and following this the urticaria disappeared.

Miss S., aged thirty-eight years, November 18, 1928. Had had urticaria at quite frequent intervals; no history of food disturbance; no trouble with sinus, tonsils or teeth. Gave $1\frac{1}{2}$ cc. distilled water, with disappearance of urticaria in twenty-four hours; there has been no return since.

The same condition has been treated with similar results in cases of urticaria in children.

In regard to eczema in its various forms, many cases have been treated in children with uniformally good results. The treatment should always be combined with the use of a tar ointment.

In the case of breast-fed babies it is found that exceedingly good results are obtained by giving the treatment to the mother in doses of from 2 to 3 cc. at weekly intervals, occasionally giving the baby 1 to 2 cc. intramuscularly.

Cyclic vomiting in children yields rapidly to this treatment; 38 cases have been treated in the past seven and a half years with good results. If the distilled water can be given intravenously in a dose from $\frac{1}{2}$ to 1 cc., depending on the age and condition of the child, the vomiting will stop within two hours. If a vein cannot be found, and the distilled water has to be given intramuscularly, from 2 to 3 cc. will stop the vomiting within five hours.

The last type of case to be mentioned is that of seasickness. A year ago, while returning from Europe, I had the opportunity to treat six steerage passengers who were exceedingly ill with *mal de mer*. They were all vomiting continuously, feeling as miserable as only a seasick person can feel. They were either Russians or Italians, to whom neither the ship's doctor nor I could explain what we were doing, therefore, there was no possibility of psychology entering

into the treatment. Five of these patients did not vomit after the treatment was given, and within six hours were on deck feeling well. The sixth case vomited once, and did not get over the effects of the illness for two days.

Conclusion. I firmly believe that if this treatment were given a fair trial, and with an open mind, used in connection with all the other medical treatments which may be applicable to the disease in question, much better results would be obtained; further, that numerous other diseases and conditions would be benefited by the intravenous use of distilled water.

THE RELATION OF WITHDRAWAL OF CEREBROSPINAL FLUID TO THE BODY TEMPERATURE; CONSIDERATION OF A THERMOREGULATORY CENTER: STUDY OF 250 CASES.*

By ALFRED GORDON, M.D.

In the course of routine examinations of the spinal fluid in neuropsychiatric cases the following peculiarity was observed, at first accidentally: Shortly after lumbar punctures a few patients complained of a general discomfort. This circumstance suggested to the nurses in attendance to take their temperature. They found a slight elevation. Intrigued by this incidental finding, I have decided to pursue further this investigation and thus commenced to gather observations on a large scale. The 250 cases presented here suggest certain ideas concerning the pathogenesis of fever and the possible localization of a thermoregulatory center. The findings somewhat differ in adults and children. The adult group consisted of: 25 hemiplegics, 5 cases of increased intracranial pressure, 17 cases of idiopathic epilepsy, 10 cases of meningitis, 40 cases of psychoneuroses, 12 cases of manicdepressive psychosis, 10 cases of transverse myelitis, 2 cases of multiple sclerosis, 15 cases of paresis, 20 cases of tabes, 40 cases of severe headache of luetic origin, 4 cases of dementia precox. The 50 cases in children consisted of 10 cases of meningitis, 15 mental defectives, 20 epileptics and 5 cases of Little's disease.

In both series the temperature was taken immediately before, but five minutes, a half-hour, one hour and three hours after the puncture of the spinal canal or of the lateral ventricles in the brain. In the adult series the rise commenced in the majority of cases five minutes and in some cases only thirty minutes later. It continued to ascend until the third hour, when it gradually descended to reach the figure before the punctures. The highest rise was 2°, the lowest was 0.5°. The more spinal fluid was withdrawn the higher the temperature went up and the sooner the rise commenced. It was exceedingly interesting to observe that whenever no spinal fluid

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could be obtained on one and even on several attempts, as it not very infrequently happens, which usually means no penetration of the needle into the dural sac, in all such cases no change of the bodily temperature could be noticed. In 5 cases with the diagnosis of serous meningitis (judging from the typical clinical symptoms and absence of specific microörganisms), there was a slight febrile state before the lumbar puncture, but the withdrawal of spinal fluid was followed by a greater rise (1° to 2.5°) than in the afebrile cases. The following interesting observation deserves special mention, as it apparently has a certain bearing on the pathogenesis of fever, which will be discussed later. In cases of evident meningeal irritation, and especially in cases of seropurulent spinal fluids in which a definite or specific microörganism cannot be determined, I am in a habit to follow the withdrawal of spinal fluid by injections of normal salt solution. In the majority of such cases I have observed no rise, but an immediate fall of the temperature after the evacuation of some of the spinal fluid, but a rapid subsequent ascension of the temperature after the salt solution had replaced the seropurulent fluid. Moreover, this rise was greater than in the cases of the ordinary lumbar punctures mentioned above (2°).

In several cases of puncture of the lateral ventricles which was done for various reasons, either for ventriculography or for the purpose of alleviating epileptic convulsions,[1] when I tentatively incriminated the choroid plexuses, in all such cases the removal even of small quantities of cerebrospinal fluid, such as 5 or 10 cc., was followed by a rise of temperature, and, curiously enough, much sooner than in the cases of lumbar puncture, namely, in two or three minutes. Like in the latter cases, the larger the quantity of fluid was withdrawn, the higher was the elevation of the temperature. When the removal of the fluid was followed by injections of air for ventriculography or of normal saline solution, as I have done in some meningeal conditions, the rise of the temperature was more marked than in the cases without secondary introduction of air or fluid into the ventricles. It must be also mentioned that the duration of the elevated temperature is greater in the ventricular than in the lumbar cases, as long as three or four, or even five hours.

The children's group of cases presented in general the same picture as the adult group, with this exception, however, that under identical circumstances and in identical pathological conditions invariably in every case the rise of the temperature was decidedly higher than in

the adult cases; when the latter showed 0.5°, the children showed 1°; when the former presented 1°, the latter had 1.5°.

In each of the two groups of cases there were some differences in the intensity and rapidity of the reaction to the withdrawal of cerebrospinal fluid. Thus, for example, the epileptic and meningeal cases gave a quicker and greater response to punctures than the hemiplegic cases. Among the psychoses the rise of the temperature in the maniacal phases was also more marked than in the depressive phases, and in the manicdepressive cases in general the rise was greater than in the psychoneuroses. The duration of the higher temperature presented correspondingly analogous differences. The cases of luetic headache presented an earlier, more prolonged and more marked reaction to punctures than the cases of tabes or paresis. As to the two latter affections, the paretic cases were more conspicuous in their reaction than the tabetic cases.

In summing up these facts special attention is invited to the following thoughts, which in my opinion are full of significance and possess a special meaning: What is the reason that a dry puncture is not followed by an elevation of temperature? What is the reason that in cases of meningitis the preëxisting febrile state becomes more accentuated after a lumbar puncture? What is the reason that in the cases of seropurulent cerebrospinal fluid the removal of some of it was followed by a hypothermia, and as soon as normal salt solution was injected into the dural sac the temperature rose? If all these phenomena cannot be explained to the full satisfaction, one fact, nevertheless, stands out conspicuously, and that is, a change in the stability or in the equilibrium of the cerebrospinal fluid, brought about either by ventricular or lumbar puncture and resulting in diminution of its quantity, produces a change in the bodily temperature. If it is so, the next question one is led to ask oneself is "by what mechanism?" Schoenfeld[2] has shown that the removal even of a small quantity of spinal fluid is followed by an increase in its cells and albumen contents. On this basis one may argue that the mechanical irritation of the meninges produced by the puncture of the dural sac results in chemical and physical changes of the fluid and consequently in hyperthermia. On the other hand, one should also take into account the meningeal irritation *per se* produced at the time of the puncture, and consider it also as one of the causative elements in the rise of temperature. Indeed Thurzo's and Nagy's[3] observation indicate this possibility.

So far our discussion on the cause of fever leads to the presence of two factors, namely, mechanical stimulation and meningeal irritation.

Auerbach[4] calls attention to the fact that an abundant loss of cerebrospinal fluid during operations on the brain and spinal cord is frequently associated with a rise of bodily temperature. This observation, as well as those of Jakobi and Roemer,[5] of Trendelenburg,[6] of Janossy and Horvath[7] suggest a new possibility, namely, that of pituitary secretions, which have been found present in cerebrospinal fluid, as being the cause of increase of bodily temperature during physical disturbances of this fluid. Whether this assumption is correct or not, it is impossible at present to ascertain with any degree of precision.

The outstanding feature in all observations recorded is that when the physical relationship of the cerebrospinal fluid is disturbed in one way or another the bodily temperature is equally disturbed. At this juncture I may mention also the following occurrence: In 1 case of progressive muscular atrophy of luetic origin, and in 1 case of hydrocephalus, the physicians in charge drained the spinal canal to the maximum. The patient's body temperature became rapidly low (97° and 96° respectively).

In presence of such facts as well as of those mentioned previously one is firmly led to this conception that not only is there a relationship of the cerebrospinal fluid to changes in the temperature but that this fluid is actually in some relationship to a thermoregulatory center. That the central nervous system, generally speaking, has a direct influence on the body temperature is well recognized. Experimental physiology has demonstrated the existence of a so-called "thermic center." Among the vast number of observations in this field, suffice it to recall the experiments of Citron and Leschke,[8] who have shown conclusively on dogs that the midbrain contains a thermic center. They infected the animals, whose temperature naturally rose, and then sectioned the midbrain. No fever was in evidence. Isenschmid, Krehl and Schnitzler[9] conclude from their own observations that the midbrain, and precisely the tuber cinereum, play an important rôle in thermoregulation. The neighborhood and especially the floor of the third ventricle are the most probable center for bodily temperature. A further step was made in the attempts to localize more accurately such a center, when Jacobi and Roemer[10] announced that not only a direct irritation, but also a transmission of a neighboring disturbing influence to the

walls of the ventricle, is apt to influence the bodily temperature. If one considers that there is a close relationship between any level of the cerebrospinal fluid within the brain, on the surface of the brain or in the spinal canal with the third ventricle, namely, by means of an anatomical communication of the lateral ventricles with the third through the foramen of Monroe, of the fourth with the third through aqueduct of Sylvius, of the fourth ventricle with cisterna magna through the foramina of Magendie and Lushka, finally of cisterna with the spinal canal without an intermediary passageway, if we also consider the fact that the cisterna magna is the area into which flows the fluid from every direction of the brain and which is therefore in a certain relationship to smaller collections of fluid at the base, also to the subarachnoid spaces on the surface of the brain; if, finally, we recognize the close connection of the fluid contents between the ventricular systems, the surface of the brain and the spinal canal, we can readily conceive that a physical disturbance of the fluid in the cerebrospinal system at one of its levels is bound to produce a more or less intense mechanical effect on the same fluid at other levels. If we also recall the above-mentioned Citron's and Lescke's experiments on the midbrain, as well as of others on the area surrounding the third ventircle, we can readily figure out the hyperthermia provoked by the lumbar or ventricular punctures observed in the series of the cases described in the present essay.

The walls of the ventricles are the only place in the central nervous system where the cerebrospinal fluid is in intimate contact with the parenchyma of nervous tissue; they are, therefore, physiological centers. It stands to reason that any physical disarrangement taking place in the cerebrospinal fluid will correspondingly cause an irritation of the ventricular walls and, therefore, of the thermic center. Removal of some fluid may produce a change in the shape or in the general configuration of the ventricle or a collapse of its walls when much fluid is withdrawn, or else it may be the point of departure for reformation of the fluid within the emptied ventricle which, as it is well known, is a rapidly developing phenomenon when the ventricles are in a pathological state.

Auerbach,[11] as it was described above, among many others, observed a rise of temperature during operative procedures on the cranium or on the spinal cord, which, of course, are usually accompanied by considerable loss of cerebrospinal fluid; the hyperthermia subsided when the fluid had again reached its normal level.

It was already mentioned that in 2 cases, through an error, a maximum removal of the spinal fluid was followed by a lowering of the bodily temperature. A low temperature has been observed in intracerebral hypertension, in hydrocephalus, also in traumatic injuries of the cervical cord. In all such cases there is undoubtedly present an undue pressure transmitted to the fourth ventricle and to the cervical cord. This pressure, physiologically speaking, means interruption of the central and peripheral pathways whose function is to regulate the bodily heat. That such pathways exist has been demonstrated repeatedly. Suffice it to mention the investigation of Freund and Grafe[12] among many others.

Whether we consider the rise or the fall of the bodily temperature in the course of manipulations of the cerebrospinal fluid irrespective of different circumstances under which individual variations are observed, the fact, nevertheless, remains that a mechanical withdrawal of a certain amount of fluid has an influence on the bodily temperature. Otherwise speaking, at that time the thermoregulatory centers are disturbed. Since the cerebrospinal fluid takes its origin in the choroid plexuses or in the ependyma or in both, it is the interior of the ventricles or, more precisely, the ventricular walls that are of a special importance in the regulation of the bodily temperature. Dilatation or else narrowing, otherwise speaking alteration in the configuration of the ventricles, which can all be brought on by physical manipulations of the cerebrospinal fluid, such as punctures of the ventricles or of the spinal canal, all produce a mechanical irritation of the bloodvessels and nerve-endings in ventricular walls and consequently change the bodily temperature. All experimental investigations indicate the third ventricle as playing the most important rôle in thermic regulation. There are several problems in this direction which require greater elaboration, such as the reformation of the fluid, the change in the chemical contents in the cerebrospinal fluid during physical manipulations of it, the question of a localized meningitis during punctures; finally, the individual variation in the rise or fall of the temperature. Further research is indicated for the solution of these problems. The object of the present work, however, was merely to call attention to the fact that in alterations of bodily temperature of so-called cerebral origin, the disturbances in the physical relationship of the cerebrospinal fluid plays a very important, if not a paramount rôle. While the subject under discussion pertains to the domain of pathological

physiology, nevertheless the practical side of it, namely, the diagnostic and prognostic value, cannot be ignored.

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ARTHRITIS*

The Mary Scott Newbold Lecture

Lecture XX

By RALPH PEMBERTON, M.D.

I welcome the opportunity of addressing you tonight upon the subject of arthritis because the invitation to do so carries with it one evidence of the awakening appreciation on the part of the profession to the great problem involved. Arthritis and rheumatoid disabilities constitute the oldest disease entity of which there is any record, as is amply illustrated in the fossilized remains of the reptiles of the Cretaceous period, long antedating the advent of man. Men of the old Stone Age suffered from arthritis, and it was, as one writer put it, the disease *par excellence* of the Egyptians. It was a cause of so much disability to the Greeks and Romans as to account for the establishment of such natural spas as Aix les Bains in France, which has had a continuous existence of two thousand years. Notwithstanding this, and the importance of the disease as one of the great problems of medicine, arthritis has received less intensive and concerted attention than many disturbances of lesser import.

Owing partly to the refractory nature of the disease itself, and partly, perhaps, to a sort of obloquy reflected from certain irregular cults of treatment, a curious inertia seems to have characterized the attitude of the profession as a whole toward arthritis for many decades. Interest and investigation in this great field have definitely not kept pace with the advance of medicine as a whole. Horace says somewhere, "*Rusticus expectat dum defluit amnis*" —"the rustic waits for the stream to run by"—and one might conclude that the profession has alike waited for the constant stream of arthritis to dry up.

Fortunately a sharp awakening from this attitude of indifference

* Read, November 7, 1928.

has recently come about. A chief factor in this has been the establishment nearly everywhere of provisions for insuring the working classes. As has not infrequently happened in medicine, interest in the problem was brought about partly through the back door, so to speak, and the profession, especially in Europe, is now somewhat in the position of being goaded on by the demands of the "sick funds" organizations, that something be done to reduce their losses from arthritic and rheumatoid disability. It will come as a surprise to some to learn that in Berlin alone the incidence of rheumatoid disability is 3.4 times greater than that due to tuberculosis. In England one-sixth of the sum expended under National Insurance Acts was for diseases classed as rheumatic and half of this was for chronic arthritis alone. In Sweden four hospitals have been created for the exclusive care of chronic arthritics. In London a very large clinic is being established under the auspices of the Red Cross for the purpose of extending the benefits of physiotherapy in a wide sense to sufferers from arthritis. Many other instances of the kind could be cited, which show beyond doubt that for the first time in the history of medicine something approaching a concerted attack is being made upon this disease.

It is of much significance to note that within the last two years a committee for the study and control of arthritis has been established in this country, largely under the originating impetus of Dr. Louis B. Wilson, director of the Mayo Foundation, whose attention was called abroad to the importance of the problem. This committee consists of a dozen representative men chosen from geographical extremes of the United States and Canada and has held two meetings. Reference will be made later to some of the steps planned and taken.

In general the attitude of the profession in Europe toward arthritis has been marked by somewhat more catholicity, especially as regards etiology, than has been the case here during the past ten years, and the American committee has reached a somewhat comparable viewpoint. One of the first steps undertaken by it was an attempt at simplification of classification, long the bugbear of students of the subject. It has been decided to recognize two great types of arthritis, atrophic and hypertrophic. This is, in fact, under other names, the classification into the proliferative and degenerative types of Nichols and Richardson. All types of arthritis, exclusive of tuberculous, are included under these heads. The

outstanding pathologic deviations are, in the atrophic type, smothering and destruction of cartilage by overgrowth of the synovial membrane, together with a destructive growth of granulation tissue from the bone below; and in the hypertrophic type, degeneration of cartilage by fibrillation, together with overgrowth of bone at the margins of the joint and elsewhere. Manifestations of the same underlying processes occur in the soft tissues also, but fall, more particularly perhaps, under the head of the atrophic variety. It is important to note, as Charcot pointed out in his Salpêtrière lectures forty years ago, that arthritis and rheumatoid disability are only branches of a large pathologic tree which has its roots in disturbances of widespread underlying physiologic processes.

In a brief article such as this, however, there is no opportunity to present at length the many factors in etiology, pathology or treatment which must be considered in any thorough review of the subject. It is rather the purpose of this paper to sound some of the newer significant notes in relation to the disease. In this connection an important conclusion of the American committee on arthritis must here be mentioned, which may come as something of a surprise to many who have accepted wholeheartedly the rather crystallized opinion in this country, of the cause of arthritis. Recognition of the importance of focal infection in a host of diseases has marked a signal advance in modern therapy and reflects credit upon American medicine more than upon that of any other country. In no other disease has the importance of focal infection been more apparent than in the case of chronic arthritis, particularly in relation to the many varieties of streptococci. So much has this been the case that, in many quarters, the rheumatoid problem has been regarded as one solely of bacteriologic nature. Suffice it to state then, that in the views of the committee focal infection or infection of any kind, though in no sense to be minimized, constitutes often only an episode in the causation of the disease, acting like "the match to the priming." Indeed, the committee has placed itself on record as believing that the underlying causes are farther to seek and are to be found, in part at least, in that background determined by heredity, constitutional makeup, the equilibrium of the nervous system, chemical and other toxins of imponderable nature and, finally, the conditions of the environment. This may seem a somewhat generic statement, and yet it is only with full consideration of the lines here implied, in the opinion of many of the committee,

that successful treatment of the disease can be carried out. One natural result of the brilliant development which bacteriology has undergone in the past five decades has been a somewhat mechanical view of the depredations of bacteria in their effects upon tissues. Wells points out, however, that practically all bacteriologic processes are at last analysis chemical in nature.

Thus, it is the view of Zinsser that rheumatic fever is an allergic condition in which the body is sensitized to a bacterial antigen. He believes this to be the only explanation consistent with the varieties of bacteria isolated through the interesting work of Small, Swift, Clauson, Cecil and others, and with the frequency with which such factors as exposure seem to precipitate the attack. Swift remarks that it is easy to understand that the state of the tissues of the patient is the most characteristic feature of the disease, and that the specificity of the streptococci recovered may play a relatively unimportant rôle. Recent evidence suggesting the passage of certain strains of streptococci from one to another is in line with this view.

It seems highly probable, by analogy, that the atrophic form of chronic arthritis may often have a comparable cause. As long ago as 1920 the present writer advanced the then somewhat iconoclastic view, based upon observations in the army, that acute inflammatory rheumatism and the exacerbations of chronic arthritis or even chronic arthritis, itself, seem to differ in degree rather than in kind.[1]

The toxicity of extracts of the organisms isolated by Small and by Birkhaug, to mention only one influence, is so marked as to lead to the hope that among arthritics as a whole a group may be found which will stand in some specific relationship to these or comparable organisms.

In view of these several considerations it would appear that even the bacteriologic causation of arthritis proceeds in many cases from a wider premise than has been generally appreciated. Zinsser says: "It is our opinion that, in that branch of general physiology which is spoken of as immunology, we have been hampered in our reasoning by adhering too closely to analogies furnished by a few antigenic substances, such as bacteria, animal cells and coagulable proteins. We are actually dealing with phenomena of much broader physiologic interest."[2] It is pertinent, therefore, to quote one sentence

[1] Pemberton *et al.:* Studies of Arthritis in the Army Based on 400 Cases, Arch. Int. Med., 1920, 25, 335.

[2] Zinsser: Boston Med. and Surg. Jour., 1927, 196, 387.

from a little brochure or primer which has been prepared by the American Committee for the Control of Rheumatism for distribution to the laity and, indeed, somewhat to the profession also. "The commonest causes of atrophic arthritis are the poisons which are set free in our bodies. These poisons may be manufactured by the growth of germs which the body's defense mechanisms are too weak to resist or by a disturbance of the normal physiology and chemistry of the body which may result from overtire and the bad use of our bodies."

In this connection should be mentioned another of the acknowledgedly prime factors in the causation of arthritis, especially of the hypertrophic type, in women. This is the menopause, and the relationship is so clear that some students, especially Cecil, have described specifically "arthritis of the menopause." In view of most observers, including Knaggs, Cecil, Osgood and Goldthwaite, hypertrophic arthritis is not of infectious or bacteriologic origin. Space has been given to the several considerations so far mentioned, because it is believed that they constitute a new "take-off" in the approach to arthritis, of significance in treatment to the many sufferers from this disease.

The present is not the time for consideration of statistics except to mention that arthritis as a whole affects women with about twice the frequency of men, that the knee is the site of greatest involvement in all groups, the fingers coming next, and that in a study based upon 1100 cases by Dr. Peirce and the writer heredity played a rôle of unsuspected importance, being obvious in 60 per cent.

Study of the morphologic changes in the arthritic syndrome has been exhaustive, but study of the dynamic pathology causative of the changes has been in general meager. How are they brought about? It is impossible to investigate a disease in which rarefication and overgrowth of bone are so conspicuous without being early impressed with the fact that it is necessary to invoke chemical reactions, in part at least, to explain the changes involving the calcium and magnesium of osseous tissue. Chemical analysis, however, of the fasting circulating blood along modern lines has been singularly unfruitful, although it has served to delimit the problem and direct attention into other channels. It may be said, however, that in arthritis, as a whole, basal metabolism tends to be low; according to Swaim and Spear, chiefly in the degenerative type. It may be mentioned, also, that there is no apparent dis-

turbance of the nitrogenous metabolism *per se*, and that there is no justification for withholding red meat from the arthritic as so long, and still so widely and erroneously, advocated. The frequency of anemia in arthritis and the importance of organs and other tissue for blood regeneration makes this a matter of large importance.

It is only when one turns to study of the arthritic, by imposing on him a physiologic load of some sort, that one detects inadequacy of response, indicative of pathologic deviation.

One line of evidence, adduced in this way, came as the result of observing that certain low dietaries were of benefit to certain types of arthritis. In the attempt to throw light upon this through laboratory studies it was ascertained that in the arthritic certain substances are removed from the blood, after ingestion by mouth, more slowly than is the case in health. In brief, 76 per cent of arthritics show actually or potentially a delay in the removal of dextrose from the blood, and in this same blood there is also a higher percentage saturation of oxygen than normally occurs. Attempts to explain this phenomenon upon chemical grounds were unsuccessful, and recourse was had to the hypothesis that the process was mechanical in nature, depending upon changes in the bloodflow. Experiments were accordingly devised in which the circulation was cut off in three limbs, with the result that, upon feeding dextrose, it was possible to induce precisely the same phenomenon as occurs in the majority of arthritics. It thus appeared that the explanation of the dextrose and oxygen values was referable to the failure of the blood to reach at least some tissues in which the removal of these substances normally quickly occurs. The cause of this interference with the circulation was conceivably to be found along the line of vasoconstriction. Attempts were accordingly made to ascertain whether the peripheral blood gave any evidence of this in terms of the blood count or other changes in the corpuscular elements.

In a series of careful studies Dr. E. G. Peirce has shown that there tends to be a difference in the blood first issuing from peripheral capillary beds in the arthritic as compared with normal persons. This difference consists in a lower red-cell count in the first-issuing drop as compared with later drops. In the normal an opposite state of affairs obtains and the count of the first drop is higher than that of subsequent drops. This can be interpreted only to mean that there are fewer cells in the peripheral vascular spaces of

arthritics or that these spaces contain unduly large amounts of fluid. That these observations are not the result of chance or technical error is well illustrated by the fact that this low cell count in arthritis can be restored to normal by many of the measures which are of value clinically to the arthritic. Thus, exercise, the salicylates, coffee, external heat and massage induce a marked return toward the normal picture.

It then became desirable to check this further, if possible, by determining the actual state of the capillaries themselves, and this was made possible by the method of direct inspection devised by Lombard fifty years ago and left buried until recently in the literature. A long series of studies was conducted upon normals and arthritics by Dr. Peirce, Dr. F. A. Cajori and the writer, as the result of which it has become reasonably clear that there is in arthritis a condition of the capillaries characterized essentially by a slow and interrupted bloodflow; constricted or, at all events, many empty vessels, and especially a generally "anemic" condition of the peripheral tissues studied. It has been possible, fortunately, to check this further by means of measures and drugs which benefit the arthritic, and it was again found that following such measures as massage, exercise and aspirin the whole picture changes to one of adequate bloodflow; only to relapse again, however, upon cessation of therapy.

Dispassionate consideration of these several observations afforded striking evidence that at least part of the pathologic deviation productive of the symptoms and morphologic changes of arthritis is to be found in the altered state of the bloodflow in the finer vessels, probably in the nature of vasoconstriction. This is precisely in keeping with the clinical observation of the frequency with which Raynaud's syndrome is encountered in the rheumatoid state. It also fits in well with the long-recognized clinical effect upon bloodflow of the measures probably most used in arthritis, such as heat, massage, etc. It remained, however, for further experiment to place the matter upon a more secure footing. This experiment consisted in the attempt to interfere in the living animal with the circulation in the neighborhood of a joint. For this purpose my associate, Dr. A. D. Goldhaft, conducted a series of experiments in which the circulation to the patella was cut off by means of a purse-string suture carried around it. Four dogs were operated upon, using the other legs as controls. It was of the greatest interest to

observe after some weeks, under the x-rays, evidence of overgrowth of bone such as is seen in the patella of human beings suffering from hypertrophic arthritis of the knee. This result was forthcoming in every animal operated upon. That it was not due to the mechanical irritation of the operation, or of the silk ligature used, was shown by the fact that an equal amount of ligature placed near the patella, without interfering with the blood supply, produced no change of organic or even functional nature. This experiment, then, coming as it did at the end of a series of observations all pointing the same way, is in agreement with the work of Wollenberg, and strongly suggests that the functional and organic changes of at least some kinds of arthritis—namely, the hypertrophic—are referable, in part at least, to a disturbance of the circulation. There is no opportunity here to point out the consequences which could be expected to follow anoxemia, not to say a relative anemia, of this kind, but disturbance of the acid-base equilibrium is generally recognized to be one of them, and the way is open for explanation of some of the changes, such as rarefication and overgrowth of bone, in which the fixed bases of the bone must necessarily take part. The tendency toward a lowered basal metabolism in arthritis is probably to be found in the same premise, viz.: a curtailment of the finer bloodflow in at least the muscular tissues.

Another line of observations which must be briefly mentioned as of significance in the attempt to understand the mechanism of arthritis is to be found in the observation, by Cajori and the writer, that certain substances which reach the gastrointestinal tract through the mouth are carried directly, after absorption by the bloodstream, to the joints themselves and can be redetected there almost immediately in the synovial fluid. Indeed, certain substances, presumably cystalloids, such as glucose, reach a higher concentration in the synovial fluid than may occur in the blood, possibly because the arterial blood supply to the joint predominates over the venous outgo. This observation affords definite evidence of a means of nourishment of the central avascular area of articular cartilage, a matter long in doubt. It also unmistakably proves that a variety of substances from the intestinal tract have access to the joint cavities. The possibility that deleterious as well as nutritive substances from the bowel may here play a rôle must henceforth be definitely considered. It may be noted, in passing, that Freiberg has recently shown that sterile bacterial filtrates

injected into the joint cavity of animals may produce changes characteristic of atrophic arthritis.

TREATMENT. A consideration of the rheumatoid problem from the viewpoint of such physiologic changes as are above described offers explanation of the *rationale* of many measures of value and suggests in an important way certain lines which treatment must follow. We do not know all that should and must be known about the disease, but there can be no doubt that information at our command today enables us definitely to take a more hopefully constructive attitude than at any time in the past. As with many other diseases, treatment must take the direction of removing possible causes, removing or modifying the functional and organic changes which the disease produces and, finally, when necessary, adjusting the burden which a handicapped organism is asked to bear. In the first connection the question of focal infection comes prominently into the foreground, but I take it that with the present audience there is small need to stress the recognized rôle which infectious processes may play. This rôle must have full emphasis in any consideration of treatment. That infectious processes do not constitute the whole picture, however, has already been stressed, and is further evidenced by the fact that in 400 cases of arthritis among soldiers during the war three times as many recovered in the presence of causative focal infection as got well following its removal. The sound position to take, of course, is to spare the subject all burdens of this nature compatible with good medical and surgical judgment after thorough and dispassionate analysis of the case. The duty of the practitioner, however, has only begun in most cases when abscessed teeth are removed or a boggy prostate is massaged. There remains in chronic arthritis following the removal of even causative infection, a more or less chronic dislocation of physiology which may persist a long time or even permanently. So much is this the case that one may almost say, once an arthritic, always potentially an arthritic. It was remarked earlier that constitutional and environmental circumstances play an important rôle in determining arthritis, and there is today small doubt that the nervous system is importantly caught up in the production of the disease. This is amply illustrated in the most extravagant expressions which arthritis takes, namely, the grotesque bony overgrowths of Charcot's joint. Specific evidence to the same end is also seen in the experiments of Rowntree, who was able to relieve, at least tempo-

rarily in two cases, all symptoms of severe atrophic arthritis of the legs by the operation of lumbar sympathectomy. The frequency with which arthritis implants itself upon individuals of asthenic and enteroptotic build forces upon the critical student of the subject the necessity of considering this background as an etiologic factor, and correcting it if permanent results are to be achieved. In this connection one of the most useful lessons ever adduced has come from the Boston orthopedists, who have developed a viewpoint of much wider value than the term orthopedic implies. This has to do with the rehabilitation of the deranged physiology in the chronic arthritic or the structurally inferior subject. The lesson is one which every internist should be able to apply to the neurasthenics and, indeed, many cardiac and other types of patients under his care. Speaking as an internist, the writer believes that internal medicine has perhaps regarded illness too often from the standpoint of the organs concerned and too little from the standpoint of the structure in which they are housed. As regards arthritis, the writer is strongly of the opinion that no one is qualified to approach this great problem who is not familiar with these measures of structural rehabilitation of the chronic invalid at large. In fully one-third of all arthritics this constitutes a foundation without which no substantial superstructure can be expected to rise.

In view of what has been said regarding the necessity of obtaining or maintaining a physiologic balance, it does not surprise us to learn that one of the most important measures to be instituted early in the treatment of the disease is rest. By this is meant systemic rest of the body as a whole, and not necessarily or only rest of the affected part, which is determined by other and local considerations. As regards the joints themselves, it is the belief of some of the most qualified observers that, in general, prolonged rest of the joint in atrophic arthritis is not desirable, whereas in hypertrophic arthritis rest of the joint affords removal of one of the causative etiologic factors. Many cases of arthritis originate in fatigue. Many more suffer fatigue from fighting the disease and from carrying on "with the fox at their vitals." Fatigue is also an expression of toxicity, and unless the sufferer be given a chance to recover from the lesser disability he will be quite unable to fight the greater.

Apart from the significance of rest as a specific measure, it has another importance in relation to various other forms of treatment, especially physiotherapy. Rest must be used in extra dosage, so

to speak, when demands are being made upon the organism to respond to various therapeutic procedures, nearly all of which exact their toll of fatigue.

Perhaps the oldest, and certainly one of the most important, categories into which treatment of the arthritic must fall is that of physiotherapy. Under the two great heads of massage and heat, sufferers from arthritis have in an untutored way themselves sought relief through these measures over periods of centuries. The value of massage, exercise and heat to internal medicine at large is just beginning to be appreciated by the profession as a whole. The recent creation of the Council on Physical Therapy of the American Medical Association can be instanced in evidence of this, and it is said to have been one of the regrets of Dr. S. Weir Mitchell, whose name is so closely associated with this hall in which we are meeting, that his efforts at extending the use of physiotherapy fell so far short of the aims he had in view.

Orthopedic surgeons and neurologists, almost alone among medical men, appreciate fully the value of massage and heat. The proper prescription of these agents is almost a specialty in itself, and it can only be added here that these measures serve the several purposes of relieving much suffering, restoring deranged physiology and modifying organic disturbances of structure.

Mention must be made of vaccine therapy and the use of nonspecific protein. The use of these measures springs directly from the bacterial origin of many cases of arthritis and needs no defense or emphasis in the treatment of infections. Their place in arthritis is established in relation to one exciting factor of the disease, but those who best understand the principles of operation best understand also the limits within which they should be employed.

The most hopeful sign in this connection proceeds from the allergic conception of the etiology of many cases of the atrophic type, and it is to be hoped that the organisms isolated by Small, together with that of Birkhaug and, more recently, Cecil, may prove to be utilizable in the direction of desensitization or increased immunity. Some encouraging results are recorded.

Nonspecific protein therapy has its origin in the same premise, and is so widely accepted, even in the treatment of paresis by malaria, as to need no particular mention. Its value in arthritis, in a limited but definite number of cases, may depend in part upon certain antigenic or other specific properties, but it is also certain

that part of the benefits are referable to the heightened metabolism induced. Instances are legion in which the symptoms of arthritis have disappeared entirely in the presence of hyperpyrexia from pneumonia or typhoid, with the increased metabolism and accelerated bloodflow which they inevitably bring about.

Coequal in importance with the bacteriologic factors in arthritis, in the usual sense of the word, and possibly surpassing them both etiologically and therapeutically, is the great field constituted by the gastrointestinal tract. Apart from the question of local foci, such as an infected gall-bladder or ulcerative colitis, the intestinal tract plays unquestionably a large rôle, dependent upon the still-unmapped processes of fragmentation of the foodstuffs and the formation of the products of normal bacteriologic activity. Ten years ago this conception had little acceptance; today it is so widely appreciated that the laity are flocking, with their well-known vogue for "cures," to the many establishments given over to colonic irrigation, facetiously referred to sometimes as "colon-filling stations." As is usually the case with new ideas in medicine, enthusiasm for this procedure runs ahead of the facts, and yet there can be no question that through this type of agency we have a means of removing or modifying one of the great causative factors of arthritis. The *rationale* of this measure is too complicated for detailed mention here, but probably depends in part upon removal of the products of bacteriologic growth. That this is not the whole explanation, however, is pretty clear from the fact that change of the intestinal flora does not necessarily have any beneficial influence. Faulty anatomy and faulty physiology of the viscera, and especially of the intestinal tract, apparently afford the basis upon which the exciting factors can become operative.

If there be value in expediting out of the gastrointestinal canal its complicated and varied contents, it should and does follow that control of the intake of the substances thus sought to be expedited should also be important. It is precisely that taken in by mouth which, in large part, is removed by irrigation. Beyond question, a large field of therapy here presents, the high points of which only can be outlined. The form which it takes is chiefly in the direction of a lowered caloric intake at large, though there is reason to believe that the starches and sweets are more deleterious than the other foodstuffs. The operation of a low dietary is probably dependent partly upon removal of the substrate on which the intestinal flora

subsist, but also upon an indirect metabolic influence which cannot be developed here because of limitations of time. One of the basal facts relating to arthritis is caught up in the influence of a heightened bloodflow and increased metabolism upon the disease. By the same token it is precisely when catabolism runs ahead of anabolism that the arthritic may experience temporarily some of the sharpest benefit. When a restricted dietary brings about this state of affairs certain cell units are apparently not only spared a previous burden but they function with a reserve potential which, while the situation lasts, constitutes physiologic equilibrium. The dangers of undernutrition, however, present limiting factors in this type of therapy, and it can be practised only with a balanced appreciation of both sides of the equation. When it happens, in suitable sthenic cases, that a reduced dietary can be accompanied by the use of physiotherapy not only is the physiologic load lightened but at the same time a metabolic fillip is also given to the flagging horse. The late Cardinal Gibbons is said to have remarked that he owed his good health to his bad digestion. Perhaps to few other types of invalids has this epigram such application in principle as to the chronic arthritic.

The field of drug therapy in general has limited value in the arthritic syndrome. Heading the list as regards relief of pain are the salicylates in their various forms, but, by and large, they serve only to afford temporary comfort and may have undesirable consequences. In the vary early stages of muscular disability their use is not infrequently sufficient to restore a perverted physiology to normal and, upon restoration of function, the physiologic balance of health may be maintained.

Superseding the salicylates in value is arsenic, one of the dozen or more irreplacable drugs of medicine. Its influence upon metabolism and regeneration of the blood elements is perhaps never more graphic than in some cases of arthritis, which may for a time improve so rapidly as to lead to belief that the cure is at hand. Other measures, of limited values, can be grouped under the general caption of those which probably hasten metabolism, such as potassium iodide and the *x*-ray. Orthoiodoxy benzoic acid, which has recently had a "flair," is a sort of glorified salicylate. It has in general not justified the claims made for it by some writers, but is a useful agent if not regarded as a specific.

Finally, mention must be made in this cavalier review of arthritis,

of the importance of coördinating various lines of treatment. It is a fundamental principle in the treatment of disease that the given load must be adjusted to handicapped organs or systems. It is further axiomatic that the restorative powers of Nature alone achieve the processes of convalescence of repair. These facts are too often overlooked, however, in the care of the arthritic, and expectation is often entertained that a drug or injection will restore atrophied muscles or remove the fibrositis and faulty physiology productive of it.

Treatment of the arthritic, with the inevitably long period of convalescence, should be somewhat analogous to the training of an athlete. Professional trainers are unanimous as to the importance of a carefully balanced program for their charges. The athlete never runs when he is tired, and he rests after his run. Massage further contributes to the efficiency of his normal muscular physiology. How much more the trainer of athletes understands the problems of his protegés than does the average physician the problem of the arthritic! The chronic arthritic is nearly always fatigued, but is nevertheless usually asked to undergo at once a variety of procedures, surgical as well as medical, which often reduce him to an even lower ebb.

The writer cannot hope, in the brief space here allotted, to discuss the details of the treatment of arthritis in the fulness they deserve. If, however, only one message could be given to this audience, it should be an exhortation to maintain a wide-angled viewpoint in considering the rheumatoid problem; to coördinate the various sound measures of therapy critically and more frequently than is usually the case and to appreciate that at last analysis it is not necessarily the removal of a focus or usually any single agent, but rather a restoration of physiology along the many lines indicated, which ushers the chronic sufferer from arthritis into channels of recovery. Pessimism has long dominated the attitude of the profession toward the chronic arthritic. A keynote sounded in the brochure of the committee already mentioned is in the opposite direction, convinced as many of its members are of the great value of treatment in this disease. It is of the highest importance that more investigation be carried out on the causes and nature of arthritis. It is of equal importance, however, that there be wider dissemination of what is already known regarding the disease. With the measures now at our command, thousands of arthritics throughout the country, probably

doomed to wheel-chair invalidism, could be saved from this and often restored to active life if these measures could be intelligently and skilfully applied. Not only are there few other diseases in which intelligent and resourceful treatment is so urgently required, there are, in fact, few other chronic diseases for which more can be done.

Arthritis touches more fields of medicine than does any other pathologic state. Its subtleties cannot be learned quickly or easily, and it is a favorable augury that this problem is now in process of taking its place with tuberculosis and syphilis as one of the great chapters of medical science. Only when this has been achieved, however, will there arise that wealth of professional equipment which alone is adequate to combat it. We are, today, in this country in the struggle against arthritis more or less in the position of Trudeau fifty years ago in the fight against tuberculosis. Those of us who have been most interested in this problem are best aware of the inadequacy of individual effort, and can only hope that the great mass of right-thinking laymen and medical men will rise, as they have so often done in the past, to the call of distress.

CANCER OF THE COLON: PATHOLOGY AND EARLY DIAGNOSIS*

The Mütter Lecture

By HUBERT W. CARSON, F.R.C.S. (Eng.)

Cancer of the colon occupies an anomalous position in abdominal surgery. With the exception of the rare colloid growths, which are very lethal, the type of cancer which attacks the colon is relatively slow-growing and metastasis is late. The technic of operation for removal of colon growths is standardized and the operations themselves present no serious difficulty, and yet the immediate mortality is high, although the late results are encouraging. The explanation for this curious state of things is that a large proportion (35 per cent of my own cases) are complicated by obstruction, of whom 57 per cent died, and that an attempt at a radical cure is possible in only a disappointing percentage of the cases (48 per cent of my cases). The bugbear of cancer of the colon is late diagnosis, and this is my excuse for bringing the subject before you in this address.

It is possible in the time at my disposal to touch only upon a few aspects of the question, and I propose, therefore, to limit my remarks to two main divisions: (1) the etiology and pathology, and (2) the early diagnosis.

Etiology and Pathology. It is important to realize that the colon, short as it is, is divided into two parts, both as regards its origin and its functions. If an imaginary line is drawn from the tip of the ninth rib on the left side, to the anterior superior spine of the iliac bone on the right side, it will cross the colon between the splenic flexure and the middle of the transverse colon. All the colon to the right side of this line is derived from the midgut, and has the same blood supply (superior mesenteric artery) as the small intestine. All the colon to the left of the line is derived from the hind-gut, and is supplied by the inferior mesenteric artery. The function of the right colon is to absorb the fluid portion of the intestinal contents; that of the left colon, to act as a reservoir for the

* Read, December 5, 1928.

waste material previous to evacuation. The contents of the cecum, ascending colon and part at least of the transverse colon are in a fluid state, and the contents of the descending, iliac and pelvic colons are more or less solid. It will readily be understood, then, that these contrasted halves of the large gut—differently developed, with different functions, and subjected to different strains—might well develop different diseases or different types of the same disease. And so it is with regard to cancer: that though nearly all colon cancers are adenocarcinomas (for spheroidal cell growths are rare) the right colon tends to give rise to large growths, freely proliferating and ulcerating, while the left colon tends to develop the small, constricting type of growth. The importance of this fact upon the symptomatology will be referred to later. There are three types of adenocarcinomas in the colon; the colloid, the scirrhus and the medullary. In the *colloid* type there is a massive invasion by the growing edge, all layers of the bowel wall being implicated simultaneously. In the *scirrhus type* the growth tends to encircle the bowel by extension along the submucous lymphatics, and extends upward and downward but little. In the *medullary* type superficial ulceration with but slight infiltration of the base is the rule. Growths of the right colon may implicate the duodenum or kidney and sometimes give rise to retrocolic abscesses; growths of the transverse colon may implicate the stomach; while descending colon growths may implicate the jejunum, which lies in contact with it. Extension by the main lymphatics is slow; so slow indeed that Haussmann, reporting upon 100 cases dying of the disease, found the condition still limited to the bowel wall in 50 per cent, and in only 33 per cent were the glands infected, a proportion which must be still further reduced in cases coming to operation. But in one situation at least lymphatic extension adversely influences the prospects of radical cure, and that is in cancer of the transverse colon, where the glands are particularly difficult to remove and the prognosis is correspondingly bad.

Some most important work on cancer of the colon has been done recently by Dr. Cuthbert Dukes, pathologist to St. Mark's Hospital for Diseases of the Rectum, in London, and published in the *British Journal of Surgery*, April, 1926. He noticed that in a large number of specimens of cancer of the colon, removed by operation and submitted to him for investigation, there were a number of minute projections of mucous membrane in the neighborhood of the growth.

Most of them were sessile, but a few were pedunculated. They looked like innocent adenomata. He examined 127 colons from patients dying of other diseases than cancer, and found one or more of these tumors somewhere between the cecum and sigmoid in 12 cases (9.4 per cent). But of 33 consecutive specimens of colon cancer removed by operation he found these tumors in 25 (75 per cent), and this in spite of the fact that he was able to examine only that portion of the colon which had been removed by operation. The average age of the 12 cases in which the simple adenomata were found in the noncancerous necropsies was forty-six years, while that of the remaining 115 cases in which no tumor was found was thirty-eight years, which is in favor of the view that these adenomata are more frequent in later years. It has long been recognized by surgeons that multiple papilloma of the colon, a curious disease that seems to run in families and to be transmitted by the female side, is often followed by cancer.[1] Dr. Dukes proceeded to make a close investigation of the adenomata in his series, and to find out, if possible, what relationship, if any, they had to the central cancer. He cut serial sections through the cancers, through the neighboring mucous membrane and through the associated adenomata. By Dr. Dukes' courtesy I am enabled to show you some of these sections. Arguing on the analogy of the production of cancer in the skin of mice subjected to tar applications, in which tumors appear in minute isolated areas of the treated patch of skin identical in appearance with the adenomata in bowel cancer, and in some of which cancerous degeneration supervened in six to ten weeks, Dr. Dukes suggests that "the first effect of the carcinogenic agent is that the epithelial cells of the mucous membrane covering an extensive area of the bowel are stimulated to more vigorous growth in many separated spots. . . . Later a crop of adenomata arise from this sensitive field, and some of these become surrounded by secondary tumors. The mucous membrane in the clefts between primary and secondary tumors is hampered in its growth and becomes folded inward . . ." causing mechanical irritation to which Dr. Dukes gives the name of "collar catarrh."

If these papillomata are seen in their early stages they will present an uniformly mucous surface, but at a later stage some of them begin to ulcerate. This ulceration always takes place at the center, and, if a vertical linear section be cut so as to include the base, as has been done by Sir Lenthal Cheatle, it will be seen that in all cases the

ulceration takes place in an area on the surface exactly opposite a point where the growth is invading the submucosa. I can show you sections where this process is obvious to the naked eye. It would be an interesting investigation to study to what extent the blood supply is interfered with at this point of penetration. Now when a growth has gone on to the stage of invasion and penetration of the submucosa it is a cancer, and if these are the early stages in the development of cancer of the colon certain speculations arise. I am not a pathologist and therefore I cannot give an opinion, but I submit the following considerations for your criticism:

1. We may agree that the old classification into a proliferating growth and an ulcerating growth should be abandoned if these are merely stages in the progress of the same condition.

2. We may argue that innocent adenomata are predisposing causes if not indeed an early stage of cancer, and very convincing evidence of this is provided by the frequent development of cancer in patients with multiple papillomata of the colon.

3. But another and perhaps more intriguing problem is that we may have to revise our ideas of the duration of cancer of the colon, or at least we may have to recognize a prolonged preliminary stage. In this respect it is interesting to compare the period necessary to induce cancer in cases known to be due to some local irritant. Cancer in mice produced by tar irritation takes about ten weeks to develop, which is about one-sixth of the life of the animal. "Mule-spinners" cancer, a cancer affecting the scrotum of men engaged in certain operations in the spinning of cotton in which oil saturates their clothing round the genitalia, develops only after some years' exposure to the oil, and we are just beginning to see cancer occurring in war wounds, none of which has been sustained less than ten years ago. Is it unreasonable to believe that cancer of the colon, if it develops in the way I have suggested, a way which resembles in many respects the onset of tar cancer in mice and mule-spinners' cancer, may also have a long history of preceding unsuspected innocent adenomata growths?

Early Diagnosis. Sir Berkeley Moynihan, speaking at the Medical Society of London in 1920, on cancer of the colon, said that the discussion ought to be opened by a general practitioner and discussed by general practitioners, and yet here am I, a surgeon, reading a paper on the subject to a College of Physicians. Sir Berkeley's view was that as the surgeon sees so large a proportion of

these cases, either in obstruction or in so advanced a condition that a radical cure is impossible, there must be some factors making for difficulty in early diagnosis, and that as it is the family doctor who sees these cases in their early stage, it would be an advantage if general practitioners would meet and discuss these difficulties. Early diagnosis is more important than cure. I can remember seeing only one really early cancer of the large bowel, and that was in the rectum of a patient who had been alarmed by a single copious bleeding occurring without defecation. Our difficulties may not, of course, be entirely medical. One cannot expect every person whose bowels have become irregular to call in his medical man, nor would the average man consider an occasional attack of abdominal pain and flatulence sufficient reason to go on the sick-list. Can you not imagine the successful business man in the prime of life, with increasing responsibilities, who finds that his work is tying him down more and more and limiting his opportunities for sport and fresh air, explaining his irregularities to himself as being due to confinement and lack of exercise resulting from his work, and meeting the difficulty by aperients, which he finds he has to take in increasing doses? And even if the patient does consult us at an early stage, do we feel justified in putting him to the expense and inconvenience of a minute scientific examination? We may ask at what stage are we justified in insisting on a barium enema, roentgen-ray examination, upon using the sigmoidoscope, and upon a chemical examination of the stools. But even without these aids to diagnosis, much may be learned by a careful cross-examination and a thorough clinical examination. What will the patient tell us? *Pain* is undoubtedly the symptom which makes the greatest impression on him, and sometimes the characters of pain are helpful in diagnosis. It is a colicky pain, more a discomfort than a pain at first, and it is felt proximal to the growth, that is, it will be felt as a small-intestine pain around the umbilicus in cecal growths, on the right side of the abdomen in growths of the ascending colon, hepatic flexure and transverse colon, and on the left side, sometimes quite low down, in pelvic-colon growths. In the later stages, when obstruction is more established, the cecum, which is the most distensible part of the large gut, becomes dilated, and the pain may be felt more over this part of the colon, even in growths low down on the left side. The pain is proximal to the growth, because it is not due to the growth itself, but to the distention and spasmodic contraction of the seg-

ment of colon above the growth. It is true that it is only in "lucky" cases that one gets this exact differentiation. *Irregularity in the action of the bowels* is another important symptom. It does not always take the form of constipation, indeed diarrhea may occur in some cases, or alternating diarrhea and constipation. The important sign is that there is a change in the patient's normal habit of defecation. It is not my experience that cancer develops in people who are the subjects of chronic constipation.

Enteroptosis and cancer of the colon do not seem to be associated. Perhaps the best generalization is to say that constipation is rare in right-sided growths and rarely absent in left-sided growths. Mucus and blood are not often observed by the patient, unless the growth is quite low down, so the patient does not give this symptom as a rule in colon growths above the rectum. As regards general symptoms, anemia, loss of weight and loss of energy are common to this as to all forms of cancer of the digestive tract. Anemia, however, is much more common in right-colon growths than in left-colon growths. Sir William Wheeler, of Dublin, suggests that this is due to the toxins of Bacillus welchii. I believe, however, that the Bacillus welchii can operate only in an alkaline medium, and generally the contents of the colon are acid. You will remember that this is one explanation of the difference in symptoms between small and large intestine obstruction, the acute toxemia in the former being ascribed to the toxins of Bacillus welchii, which has led to the treatment of this toxemia by *antigas-gangrene* serum. Loss of weight and loss of energy are relatively late symptoms, much later than in the case of cancer of the stomach; indeed, it is quite common for patients with fairly advanced cancers of the colon to express themselves as being in perfect health except for some pain and irregularity of the bowels. But as the majority of cases come late to the surgeon, it is my experience that loss of weight is a common symptom. Indeed, in my last 33 cases, in which the weight is specifically mentioned, 31 had noticed loss of weight, of whom 4 had had severe loss of weight and 2 only said their weight had been maintained.

When we come to the *clinical examination* we find the signs vary according to the presence or absence of obstruction. If there is no obstruction there will be no distention or sign of increased peristalsis, but the cecum, which is very responsive to back pressure, however slight, may be full as the result of previous distention. There will

be no rigidity and probably no tender points, though if there is tenderness it is more likely to be in one or other iliac fossa, according to the situation of the growth. The growth is palpable only if it occurs in any of three situations: in the right colon, because right-colon growths tend to relatively large tumors, and they are immediately below the abdominal wall; transverse-colon growths, because, although they are relatively small, they are near the surface and often have a fecal collection behind them; and sigmoid-flexure growths for the same reason. Growths in the splenic flexure can rarely be palpated, owing to their situation; and descending-colon growths are small, generally more or less fixed to the posterior abdominal wall, and are separated from the anterior abdominal wall by coils of the jejunum. Pelvic-colon growths, which are the most common of all, can sometimes be palpated through the anterior wall of the rectum, and this makes it essential that a rectal examination, made bimanually and as carefully as you would make an examination of the female pelvic organs, should be made in every case of suspected colon growth. It has been said that a rectal examination is an essential part of the investigation of any patient suffering from a pain anywhere between the umbilicus and the knee.

The four main ancillary methods of diagnosis are:

1. A roentgen-ray examination after a barium meal, or preferably enema.
2. Examination with the sigmoidoscope.
3. Chemical examination of the feces.
4. Exploratory laparotomy.

Each of these methods has its value; each its own difficulties. They must be taken not as diagnostic in themselves, but as a part of the evidence collected and collated with other signs.

The Roentgen-ray Examination. The roentgen-ray examination is the most valuable of the four, especially the examination after an enema. It must be remembered, though, that quite large growths will occasionally show no sign, and there are certain difficulties in the examination which have to be recognized and overcome. The introduction of the enema causes a spasm of the rectum, and when this relaxes the rectum balloons up so that the pelvis seems to be filled with the barium shadow. A temporary spasm occurs at the pelvirectal junction, and until this is overcome the barium does not flow into the sigmoid. The ballooning of the rectum may obscure

the shadow of the pelvirectal junction, and even if it does not, the spasm, if persistent, will cause a filling defect which may be mistaken for a growth. After entering the sigmoid flexure the barium runs smoothly on until it reaches the right colon, but here again it may be held up by an air-lock which may give the appearance of a filling defect. This is most likely to occur in the cecum, and is easily recognized if the possibility of its occurrence is remembered. Finally, in quite half the cases in normal people, the ileocecal valve is incompetent, and allows the barium to run through into the lower cells of the ileum, where it may obstruct the view of the pelvic-colon shadow. These spasms and air-locks can be overcome by lowering the douche can, by patience, by palpation and by turning the patient on his side or on his face; but to obtain a picture free from error requires considerable skill. It happens, too, sometimes, that in spite of careful preparation a fecal mass may remain in the colon and simulate a filling defect, while in other cases the early efforts of the colon to expel the barium enema may give rise to an appearance resembling a neoplasm. How, then, are we to differentiate between a true and a false filling defect? The spasm is relatively easy; the outline of the defect is smooth; the hiatus narrow and regular. Patience with posture and palpation and lowering of the douche can well induce relaxation and the picture alters. A fecal mass may be puzzling, but here again the outline of the gut *lumen* is smooth and even, and the fecal mass may be recognized as a shadow of lighter density than the barium. The air-lock is more difficult, as the filling defect has an irregular border, but if the rule is observed that no examination is complete until the cecum has been filled, most of the difficulties due to air-lock will disappear.

What is the characteristic roentgen-ray appearance of a neoplasm of the colon as seen after a barium enema? As the barium reaches the growth, there is a temporary check, leading to some dilatation of the gut below the growth. As the barium passes on, a spike appears at the upper point of the shadow, gradually elongating until it reaches above the growth, where it expands to occupy the lumen. On examining a picture of this narrowed portion of the barium shadow it will be found to present irregularities upon both sides or upon only one side, according as the growth has encircled the gut completely or partially. This irregularity appears as indentations projecting toward the lumen of the gut, just as if the gut had been pushed inward by the pressure of the finger-tips. It has been given

the name of the finger-print defect. This defect is permanent and persists in spite of all manipulation.

The roentgen-ray appearance of the barium shadow in cancer of the colon after a barium meal is rather different and not so conclusive. This is due to the fact that while the colon after the enema presents a uniformly smooth and even contour, after the meal the colon distal to the hepatic flexure presents innumerable hiatuses known as haustration, due to peristaltic contraction. Above the growth there will be a certain amount of distention, and it may be possible to see a rat-tail prolongation, but this is never so clear as in the enema picture.

I should say that growths in the right colon give a clearer picture than left-colon growths by this method, but the occurrence of an evacuation between one picture and the next in the series may lead to disappointment. I may close this section by saying that positive evidence is of much more value as proof of the existence of a growth than negative evidence is of its nonexistence; or to put it in other words, if the roentgen-ray evidence is negative, this must not be accepted by itself as proof that no growth exists.

Examination by Sigmoidoscope. Examination by sigmoidoscope is of definite value in growths low down in the sigmoid. The examination presents no difficulties, and therefore this instrument should not be looked upon as one which should be used only by the expert. Nor is it necessary as a rule to administer an anesthetic. There are, however, one or two points in the preparation of a patient for this examination that are worth mentioning. Most important of all is the rule that the colon must not be washed out on the day of examination. The reason for this is twofold. If the washout is given a short time before the examination, it is almost impossible to get rid of all the fluid, and the examination is much hampered by watery feces which obscure the view and need constant mopping away. The other reason is still more important. It often happens that the existence of a sigmoid growth out of sight through the sigmoidoscope is shown by a discharge of blood or pus trickling down from above. This sign is of much importance, and would be destroyed by any recent lavage of the colon. It is of value, too, to obtain through the sigmoidoscope a specimen of feces, uncontaminated by possible hemorrhage from hemorrhoids, for chemical examination for occult blood. The best way to prepare a patient for sigmoidoscope examination is to ensure, preferably by castor

oil, a thorough evacuation on the day before the examination, followed by a washout on the evening of the day before the examination. In most cases a growth presents a very typical appearance through the sigmoidoscope, but it must be remembered that an innocent adenoma may look just like a cancer, and that it is impossible through the sigmoidoscope to satisfy oneself of the presence of induration of the base, which is the important differentiating sign. But the mere fact that adenomata are seen is suggestive, as I have shown earlier. The question arises whether it is possible through the sigmoidoscope to remove a portion of growth upon which an opinion can be expressed by microscopic examination. Pathologists are agreed, I believe, that too much reliance cannot be placed on the magnification of individual cells. With isolated cells the highest magnification cannot distinguish the malignant from the benign. The only part which gives the pathologist a real chance of pronouncing a definite opinion, is the growing edge, showing normal epithelium side by side with the neoplastic. Here, too, could best be seen the nuclear peculiarities of malignant cells. But it is obvious that there are serious mechanical difficulties in removing by a punch the exact area required. A punch specially designed for this purpose is obtainable, but I am afraid that we must not expect to obtain much help from this means of investigation, though Dr. Dukes tells us the results are improving.

Examination of the Feces. The feces may be examined microscopically and chemically. *A naked-eye examination* of the feces is of some value. A solid stool, even if accompanied by mucus, is against the diagnosis, but the presence of pus or blood is suggestive, and demands further examination. Fluid or semifluid stools with pus and blood are more suggestive of ulcerative colitis than of cancer, but if fragments of solid stool are found with it, a growth low down in the sigmoid may be suspected. Visible blood and pus are hardly ever observed in cancer proximal to the pelvic colon. *Microscopic* examination is very disappointing. It is almost impossible to pick out a portion of tissue from the growth in the stool, and even if it were possible it would not come from the growing edge, and therefore would be valueless for an opinion. A *chemical* examination for occult blood is of more value. In practically every case of cancer of the colon occult blood can be demonstrated, either by the guaiac or benzidine test. It is rarely necessary to do a spectroscope test; but if it is done, the acid hematin spectrum

is of special importance, as Hurst says it is rarely seen in cancer of the stomach or ulcer of the stomach and duodenum except after large hemorrhages.

Exploratory Laparotomy. The last method available is exploratory laparotomy. We may take it as an undoubted fact that many cases of early colonic cancer could be diagnosed by this means, and lives saved which are now lost by waiting for unequivocal signs. We must remember that cancer of the colon bears an unenviable reputation in that it, almost alone among cancers of the digestive tract, may discover itself by an onset of such gravity that the patient's life is at once in jeopardy. We have all seen cases where the first sign, so far as our patient can tell us, was a diffuse peritonitis due to perforation of the bowel at or above a cancer. Men apparently in perfect health, with no anemia, no wasting, no obvious variation from their normal habit, are found with advanced peritoneal metastasis from colon cancer. I had a case, only this summer, of a man who discovered a large lump in the right side of his abdomen quite by accident, who at operation was found to have a massive tumor of the ascending colon, with a secondary growth in the liver. Of course, these cases really give symptoms which, if they had been brought to the notice of a medical man, would have led to examination and diagnosis, but the insidiousness of the preliminary symptoms are so well known in the profession that the occurrence of even the slightest and most transient divergencies from the normal should put the medical man on his guard. We have seen, however, that even the most minute investigation may fail to adduce evidence which will make the diagnosis absolute. In such cases an exploratory laparotomy is the last resource, and it is well that we should form some principles to guide us in the choice of cases when an exploration should be advised. At the present time, when so much time elapses between the onset and the visit to the surgeon, the number of doubtful cases is relatively small and exploratory laparotomy is rarely advocated; but if the public and the profession realized the importance of minor irregularities, many more early cases would be sent to the surgeon, and in these cases the signs and symptoms would be more elusive, and exploration would be more often performed. Doubtless, a certain proportion of these explorations would prove negative, but no harm would result other than loss of time and the other inconveniences arising from the convalescence, but many early cases would be detected and a cure obtained.

What, then, are the circumstances which would justify an exploration? It is obvious that no exploration should be done until a minute examination has been conducted, and in some we may have no sign, in others perhaps only one or two signs, the others necessary to complete the picture being absent. We have the patient complaining of symptoms characteristic of colon cancer, in whom the only sign is an irregularity in the contour of the sigmoid flexure to the roentgen-ray barium enema. Is this irregularity the result of an early growth or an adhesion? Even the presence of occult blood in the stools is not enough to answer this question, for an adhesion can give rise to occult blood in the stools. Or, again, an irregularity in the cecal contour is noticed. Is this a malignant growth or an ileocecal tuberculosis? The roentgen-rays will not determine this differentiation. Or suppose occult blood is found constantly without other signs. Does this come from the colon or from the stomach or the duodenum, or is it accidental in some way? Or, most difficult of all, the case with symptoms but no signs. Every case demands an individual judgment, but time must not be wasted. There is no justification in waiting until some sign makes the diagnosis clear. The sign when it comes will probably be an attack of obstruction, and the favorable moment for intervention is passed. Still less is there justification for the treatment of symptoms in the absence of diagnosis. That is the main cause of disaster. My advice is that if there are any suggestive symptoms occurring in a patient of cancer age, remembering that colon cancer is not a disease of very advanced age, but with no equivocal sign, the surgeon should talk the matter over frankly with the patient, advising an exploration with the assurance that the risk is negligible.

REFERENCE

[1] Mummery and Lockhart: Cancer and Heredity, Lancet, 1925, p. 427.

APPENDIX

INTRODUCTORY NOTE TO THE SECTIONS

Almost all of the papers read before the various sections of the College are subsequently published in full in medical periodicals.

The papers listed in the following pages may be found by consulting the *Index Medicus*, provided a sufficient length of time has elapsed from the date of publication to the next succeeding quarterly number of the *Index Medicus*.—[Editor.]

PROCEEDINGS

OF THE

SECTION ON OPHTHALMOLOGY

JANUARY 1928, TO DECEMBER, 1928

JANUARY 19

Report of Operation for Ptosis of the Lid.

In the October number of the *Annals of Ophthalmology* for 1907, Dr. William T. Shoemaker, in discussing the Motais operation, said he did not believe the middle third of the superior rectus tendon, which was implanted in a pocket between the superior tarsus and orbicularis, took on the physiological function of the levator tendon, but that the lid became fastened to a fixed position on the eyeball.

He suggested, instead of detaching the middle third as is done in the Motais operation, simply attaching the tendon to the upper portion of the superior tarsus, following the principle advanced by Parinaud, in 1897.

The approach of tendon and tarsus was made by the open method, which consists in making an incision through the entire thickness of the lid, in the fold which is located at the upper border of the tarsus.

This was followed in the case shown this evening.

Discussion. Dr. W. T. Shoemaker said the analysis of the Motais principle and the Motais operation would show, he thought, that the procedure practised by Dr. Scarlett in this case is the most logical one for this class of operation. It meets every requirement of the original Motais operation, is much more easily done and is free from the well-known hazards of the Motais. It is a modification of the operation devised by Parinaud in 1897.

He would make two further suggestions: first, the suture might be carried to the conjunctival surface of the lid at the upper border of the tarsus, thus making the operation entirely subcutaneous and causing no bridling or

disfigurement of the skin surface; second, instead of including in the suture the entire tendon of the superior rectus, if only the middle third were included there would be less danger of strangulation and separation.

A Case of Pseudoneuritis

Dr. Warren S. Reese exhibited two cases of pseudoneuritis. The first was a girl, aged fourteen years, in whom the disks were elevated from two to three diopters. This elevation, unlike the usual case of pseudoneuritis, extended for some distance away from the disk and came down gradually to the retinal level. There were no definite signs of inflammation or vascular disturbance. The fields were normal except for some enlargement of the blind spots. There was myopia of one and one-half diopters. From the history, it seemed possible that she may have been hyperopic originally.

The second case was the father of the above-mentioned girl. He had a convergent squint and exhibited the usual type of pseudoneuritis, the left disk also showing a small patch of drusen.

Dr. Reese also showed a colored man with a large, dark, somewhat scaly lesion of the left lower lid. It extended to the bridge of the nose and was nodular in character at its periphery. The left eye presented numerous balloon-like constrictions of the conjunctiva and the fornices were much shortened. The cornea was practically concealed by redundant, overhanging conjunctiva. The case looked like one of lupus, but the bulbar involvement was a very unusual feature.

Epithelial Dystrophy of the Cornea which Disappeared upon the Ingestion of Fats

Dr. H. Maxwell Langdon said that the relation which fat-soluble vitamines bear to certain degenerative conditions of the cornea was first called to the attention of ophthalmologists by Osbourne and Mendel, in 1915. They reported the development of keratomalacia in rats which had been fed on a diet in which vitamine A was absent; later, Osbourne produced the same results in many other animals. The first signs of the oncoming ocular changes were an increase in lacrimation; later this became less and the tears became serosanguinous; hyalinization of the conjunctiva followed and then corneal involvement.

Before this, in 1910, Fuchs had given identity to epithelial dystrophy of the cornea, reporting 13 cases in his original monograph. Also cases have been reported by Reese, Knapp, Guist, Uhthoff, Whitham, Friedenwald, Rogers, Gifford, Holloway and others. The only one to have a very definite feeling as to the probable etiological factor was Whitham, who reports 2 cases, both patients being diabetics and the ocular changes varying with the alteration of the diets and consequent amount of sugar in the urine and blood.

The case which is here reported is that of Mrs. M. E., aged thirty-two years, seen on the eighteenth of last May through the kindness of Dr. A. A. Eshner. She had had irritable eyes for a year, considerable lacrimation and photophobia, but no pain. Her vision blurred and some glasses which she had gotten when the trouble first started did not help her. She had been working very hard, not resting well and had lost 10 pounds in weight. There was no cough or dyspnea, her bowels were regular, no headaches or vertigo. She did not use alcohol. Had two healthy children and no miscarriages. Heart, lungs, abdomen and throat negative. Bloodpressure, 110 systolic, 65 diastolic. Urine had a specific gravity of 1000, no albumin or sugar. Her diet was peculiar in that she never ate butter, eggs, nor drank milk. Her vision was 5/10 in each eye, which correction of her hyperopia and astigmatism did not improve. Both corneas showed irregular, small, gray blebs of the epithelium, arranged in an irregular, horizontal band across the central portion of each eye, about eight or ten in number. Bowman's membrane was not involved. The conjunctivæ were slightly injected, but three was no ciliary injection. The anterior chambers, pupils and irides were normal. Tension was 18 mm. in each eye. Except for the hazy areas in the corneas, the media were clear and the fundi normal.

She was given a boric and holocain lotion, a tonic of iron, quinine and strychnine, cod-liver oil, a teaspoonful *t. i. d.*, and milk and butter added to her diet-list. In a week the corneas were distinctly better, the blebs being smaller and this improvement continued until July 12, two months after her first visit. Corrected vision was 5/5 and the corneas were quite clear. There has been no return of the condition.

The course of this case naturally raises the thought that the production factor was a dietary one, possibly the lack of vitamin A; if considered in conjunction with Whitham's two cases it suggests the possibility of a disturbed balance between the fats and carbohydrates. Whitham lessened the latter in his cases and we increased

the former in ours, and in both instances there was decided ocular improvement; in ours, which was seen in a much earlier stage than Whitham's, a complete cure resulted.

Comparison of Retinoscopy by the Streak Method and by the Plane Mirror

Dr. H. Maxwell Langdon stated that any procedures which have been so long unchanged as our methods of retinoscopy are likely to gradually drift into that category of fixed things so well exemplified by the laws of the Medes and Persians; the tendency is to look askance at any suggested alteration. When it was stated that a streak of light projected from a self-projected instrument was more satisfactory than the ball of light reflected from a plane mirror, which had hitherto been the object of the gaze of the retinoscopist, it seemed well to look into the proposition.

One statement which the deviser of the instrument makes, and which is, according to the experience of the writer, quite wrong, is that by the plane-mirror method the part of the pupil studied has been the "shadow," meaning by that the unilluminated portion. As far as the writer's knowledge goes, the central bright spot has always been the thing for consideration.

By means of changing the relation of the lamp and the mirror which reflects the light in the new instrument, the effect of either a plane or a concave mirror may be obtained. The inventor thinks that it is easier to study a light moving in the pupil "with" the motion of the mirror rather than "against," and, therefore, advises the adjustment which gives the concave-mirror effect for the study of myopic eyes. This may be a help to some, but the writer thinks that the conditions are debatable. It seems to him that, given errors of like degree, there is but little choice in the ease of the determination of the movement of the light, whether with or against.

The streak may be made fairly broad or a fine line, and the latter is advised for small, presbyopic pupils where retinoscopy *sine* mydriasis is at times helpful. This seemed very probably a useful feature of the instrument, and the writer was surprised when he found the motion of the image of the lamp with the ordinary plane mirror was more readily observed than the finest streak possible with the new instrument. This has been confirmed by other observers.

One thing very quickly missed with the streak method is the ease of determining the presence of astigmatism by the band of light found in the pupil, and also the axis of the astigmatism. With the new instrument the streak must be rotated by a collar on the handle through the different meridians, and the question of astigmatism settled by the variations in the power of the lenses required to bring about a reversal of the movement. This is much slower and more complicated than the old method and yields results no more accurate.

The instrument is quite expensive, and in the experience of the writer does not justify itself either in simplicity of method or accuracy of results.

Tucking Operation for Squint

Dr. C. E. G. Shannon and Dr. William. J. Harrison (by invitation) reported 15 cases of functional squint operated upon by the tucking method. The Harrison tucker, devised by one of them (Dr. Harrison), proved in their hands easier to handle than the Todd tucker, employed successfully by some operators, and greatly simplified the entire operative procedure. The results in most of the cases were gratifying. In 12 out of 15 cases the eyes, following the operation, were apparently straight. The amount of squint varied from 30 to 45 degrees. In squints up to 30 degrees, but one side was operated upon; above this, both sides.

The instrument is similar to that devised by Bishop, later that by Birch, and consists of two principal parts: first, the equivalent to a spring forceps, the blades of which may be approximated by means of a nut and threaded bar; second, a hook situated between the forcep blades, and which may be raised or lowered with respect thereto by means of a wing-nut at the upper extremity.

Technic of the Operation. The instrument is applied perpendicularly to the muscle, with the cross-bars forming its base squarely at right angles to the edge of the muscle; the hook is lowered sufficiently to be passed under the muscle; then, by means of the wing-nut, the hook is raised, drawing the muscle up between the blades of the forceps. When sufficient length of muscle has been reached, the forceps is closed by means of the round nut at the side of the instrument, and the muscle, in the form of a loop, is securely held, while a double suture guided by the notch at the extremities of the blades is placed through the center of the muscle. This notch is important,

as it eliminates any injury to the sclera and facilitates the passage of the needle through the muscle. The suture is then severed at the needle end and the two halves of the muscle tied off. There is no difficulty in placing the knot of each half of the tuck directly under the blade.

Advantages of the Instrument. It is simple in construction and operation. It is easily sterilizable. The amount of muscle tucked is easily seen. The closure of the blades on the muscle tuck prevents traction on the suture as it is being tied, giving a secure, tight knot. Lastly, the notch in the instrument prevents injury to the sclera in the introduction of the suture through the muscle.

Advantages of the Operation. It is safe; it is a comparatively simple operation, as no sutures are taken except to tie off the loop and close the wound; the sutures never slip or tear, as occasionally noted in the Worth or Reese operation.

Several objections have been raised which warrant consideration. First, the necessity for ether administration in the performance of this operation. This is to some extent a handicap, but not insurmountable, provided careful measurement of the squint is taken before the operation. Second, that torsion might occur if there was any slight variation in the distance of the two lateral sutures from the cornea. Third, that there is frequently quite a lump which remains for months. In our series of cases it has not occurred to such an extent as to justify an objectionable after-effect. The elevation over the area of operation has flattened out satisfactorily in the course of two or three months.

Discussion. Dr. C. R. Heed said he had not been favorably impressed by the first 6 cases of the tucking operations in which the Todd tucker was used. Following the operation there was a marked reaction, extreme chemosis, considerable pain, and signs of tenonitis, which definitely interfered with a proper adjustment, and the ultimate results were not encouraging. Since the introduction of the new instrument, devised by Dr. Harrison, the operation has not only been greatly simplified, but the objectionable reaction has been entirely eliminated and the first results were most satisfactory. In all cases where a general anesthetic must be used, he believes the tucking method with the Harrison tucker an operation of choice.

Syringocystoma of Eyelids

Dr. S. S. Greenbaum (by invitation) said that syringocystoma of the eyelids is seen both in the male and in the female, but is much

commoner in the latter. It generally develops after the age of twenty and shows no tendency to spontaneous disappearance. It is most commonly situated on the lower eyelids in groups of two, three or more lesions, but likewise occurs, though less frequently, upon the upper lids. It appears in the form of small pinhead and slightly larger-sized, soft, discrete lesions. They are skin-colored, only lighter or perhaps slightly yellow, in such a way that they stand out clearly from the surrounding normal skin.

They are not infiltrated and the palpating finger merely finds that they blend with the surrounding skin or perhaps give a slight sensation of depressibility. They are flattened and appear in most instances to be slightly elevated above the skin level. Although this elevated appearance is lost on stretching the skin, the lesions themselves are not obliterated. Upon puncture, one merely obtains a drop or two of blood. There are no subjective symptoms and the patient commonly comes asking for relief for esthetic reasons.

Sections of this tissue for histological study were removed in the case of the patient shown in the second photograph and stained with hematoxylin and eosin. (Serial section study No. 1.) From the patient shown in photograph No. 3, the writer removed the lesion on the lower right eyelid, which was conspicuous by its size, firm, closely simulated what has been variously described as trichoepithelioma, benign cystic epthelioma or acanthoma, adenoides cysticum, etc., and which appeared to have developed from one of the usual types. (Serial section study No. 2.)

1. *Serial Section Study No.* 1. The epidermis was found more or less intact throughout. Most of the changes were in the derm and more particularly in its superficial parts. These changes consisted in the presence of epithelial tracts, the cells of which were polygonal or elongated, and sometimes only consisting of two or three rows of cells looking like sweat-gland ducts, but without a lumen. In these at some point centrally or peripherally, or occupying almost the entire epithelial collection, were round, oval or irregularly cystic formations in whose cavities one frequently found a pale and occasionally a bright pink-staining, granular or homogeneous hyalin material.

The term syringocystoma (coming from *syrinx*, a tube, and *cystoma*, new growth consisting of cysts) clearly describes these cylindrical epithelial tracts with numerous tubelike canals coursing

through them. They do not appear to have their origin in sweat-gland ducts, as is thought by some foreign observers who have termed them hidradenomas.

2. *Serial Section Study No.* 2. The epidermis showed little or no change. In the derm were numerous collections of epithelial cells in which were variously-sized cyst cavities, some of which contained a granular débris. At certain points these epithelial masses appears to be connected with the epidermis. Other sections showed epithelial-cell collections with and without cystic change, but all were surrounded by a more or less marked connective-tissue capsule. A definite relationship seemed present between the hair follicles and some of these cell collections. The morphological appearance was that of a trichoepithelioma.

Syringocystomas are readily diagnosed clinically. They may be distinguished from milia by the fact that these latter are whitish, firm, cystic lesions which disappear on puncture and expression of their contents. From xanthelasma or xanthoma planum they are easily distinguishable in marked or moderately marked instances of this latter condition. In mild cases there may be some difficulty, but the tendency of xanthomatous lesions to locate on the eyelid close to the inner canthus, their definitely yellow color and the generally larger patch of eruption should serve as distinguishing features. The histological appearance is, of course, altogether different.

In molluscum contagiosum the lesions are definitely elevated above the skin surface, have a distinctly waxy appearance and, on close inspection, one generally finds a minute, rounded, follicular orifice at their apex through which may be expressed a cheesy material. Fibromata are usually single, hard, elevated newgrowths, as are verruca, except that in this location the latter are apt to be filiform and, in the type known as flat juvenile warts, accompanied by many other lesions scattered over the face.

Tricoepithelioma, or multiple benign cystic epithelioma as generally described, consists in lesions which are firm, elevated to a variable degree above the surface and which have a pearly appearance. The microscopic picture is likewise different. Reference has already been made to the possibility of a distinct relationship between these two conditions.

The treatment of syringocystoma, when demanded, consists in destroying each lesion with the microbrenner.

FEBRUARY 16

A Further Report upon an Orbital Tumor

Dr. H. O. Sloane (by invitation) demonstrated this case before the Section a few months previously to show the condition of the patient previous to operation. At that time, the patient, a youth, aged nineteen years, presented a marked displacement of his right eye together with its appendages, so that it was 15 mm. below its fellow-eye and proptosed about 4 mm. There was tumefaction below the supraorbital rim, but no inflammatory symptoms. The mass was fairly firm to touch, but not hard. It could not be indented. There was a history of injury at the age of ten, but he believed there was no connection with this condition. Negative personal and family history.

The ophthalmoscopic examination showed an optic neuritis. Vision was reduced to 20/200. The conjunctiva was slightly injected; the cornea had a small nebula in the center; the pupil was regular and reacted normally to light and convergence. Rotation was limited upward. The palpebral fissure was 2 mm. narrower than the left. Tension was normal. Left eye normal.

The patient was studied at the Mt. Sinai Hospital and found to be normal both from a serological and medical standpoint. The *x*-ray showed some separation of the sutures of the skull and a normal sella turcica. The ethmoids and sphenoids were cloudy and the right frontal sinus was small and cloudy. The right orbit was enormously enlarged and there appeared to be a direct communication with the frontal sinus.

Field studies showed a slight enlargement of the blind spot and a concentric contraction for form and colors.

The patient was operated upon November 28, 1927. An incision was made at the supraorbital rim; the tissues were cut through and the orbital cavity was exposed, in which was found a mass of grayish-white tissue, lying perfectly free and not encapsulated, consisting of many particles, both large and small, soft in consistency, the larger ones appearing to have convolutions similar to that of brain tissue, filling the entire cavity and plugging the sphenoidal fissure, through which channel it appeared to be forcing its way. No attempt was made to enter the fissure. The orbital plate of the ethmoid bone was fractured and displaced in the cavity, but it was

not necrosed. There was no communication found between the frontal sinus and the cavity. The mass of tissue was removed as much as possible and the wound closed with interupted sutures, leaving a small gauze drain, which was removed in a few days after the operation.

A diagnosis of cephalocele was made at the time of operation (Dr. C. W. LeFever). The specimen was sent to the laboratory, but a complete report of the examination has not been made up to this time. A preliminary report from Dr. I. Davidson, director of the laboratory, was as follows:

> The macroscopic examination showed a large amount of amorphous material. The bulk of it was cheesy and pinkish-red in color. There are soft particles which show complete absence of any kind of structure. The other parts are membranes, white in color and soft in consistency. There is also a small piece of bone present.
>
> The microscopic examination is as follows: Paraffin sections were run through and showed exclusively necrotic tissues, without any definite morphology. Frozen sections gave the same result.
>
> Above studies did not permit any definite conclusions as to the nature of the material removed. There was no evidence, however, of any malignant material. Examination of the bone shown no evidence of necrosis.
>
> The specimen was also sent to Dr. Alfred Gordon, neuropathologist to the hospital, for study.

The patient made a good recovery and left the hospital on December 9. At this date the patient has 20/20 vision in this eye. The optic neuritis has disappeared practically entirely and his field studies show a very slight degree of enlargement. There is still some concentric contraction, especially of the upper field. The eyeball is now displaced only 5 mm. below its fellow-eye. He has 15 degrees of right hyperphoria, and 6 degrees of exophoria. The necessary lenses to correct his refractive error were ordered and an 8-degree prism added, base down, in order to overcome the hyperphoria and also the diplopia which he developed when attempting to use both eyes. At the present time he has binocular vision without diplopia.

The problem in this case was to make a correct diagnosis preceding the operation. Many attempts were made (sarcoma, dermoid cyst, mucocele, gumma, neurofibroma, angioma, cavernous sinus disease, aneurysm, cold abscess, etc.), but apparently none of these

was correct. In one of our large institutions a diagnosis was made of a maldeveloped orbital cavity, and removal of the eye was advised. The question has not been settled as to the exact nature of the mass removed, but it is felt that it is a cephalocele.

Discussion. Dr. Edward A. Shumway said that the pathologist's report in Dr. Sloane's case of the presence of degenerated, grumous material and apparent extension through the sphenoidal fissure, suggested a dermoid or cholesteatoma which had entered the orbit from the cranial cavity. A number of such growths had been reported. The cholesteatomas were more common in the region of the pituitary body, as an outgrowth from Rathke's pouch, from which the anterior part of the pituitary body develops, while the dermoids more frequently arise in the pineal region.

He had reported briefly before the American Ophthalmological Society in 1926, in a discussion, the case of a boy who had a slowly developing growth which caused marked proptosis and bulging of the side of the head, with destruction of the sphenoids and sella turcica, which he thought was due to a cholesteatoma, but no operation was permitted.

Recently a woman, aged fifty-six years, had come under his observation with proptosis and commencing restriction of the fields, approximating homonomous hemianopsia, although central vision was still unaffected. *X*-rays showed destruction of the sella and necrosis of the posterior wall of the orbit, and the condition was evidently a slow-growing pituitary-body tumor extending into the orbit. He suggested that Dr. Sloane ask the pathologist to hunt for cholesterin plates in the material sent for examination.

In closing, Dr. Sloane stated that special attention was given to the character of the tumor removed. There was none of the characteristic tissue of dermoid found in the mass, either macroscopically or microscopically, as reported by the laboratory findings. Furthermore, the *x*-rays showed no involvement of the sella turcica or pineal gland. The theory of encephalocele was based on the fact that the *x*-ray showed a separation of the sutures of the cranial vault, showing that there must have been some intracranial pressure during infancy or even prenatally, and this gradually forced some of the brain tissue through the sphenoidal fissure.

As to the question of mucocele, raised by Dr. Holloway, there was no glairy mucus in the mass, and it was not encapsulated. At first it was thought possible that there was some degenerated polypoid tissue coming from the frontal sinus, but no communication was found with the frontal sinus. The displaced bone was the paper plate of the ethmoid, and this was fractured due to constant pressure. This, however, was not diseased bone and showed no evidence of necrosis. It was regretted very much that the laboratory report was not completed, but it was hoped to obtain it in the near future, and with this evidence in hand Dr. Sloane hoped to be able to state definitely the nature of the mass of tissue found at operation.

A Case of Congenital Disk-shaped Cataract

Dr. William Zentmayer reported the case of a white child, aged two years, who presented in both eyes a dense-white disk-shaped opacity, about 2.5 mm. in diameter, surrounded by a striated zone of lesser density, in the pupillary area behind the plane of the iris.

An incision was made in the medial circumference of the opacity, which caused the opaque disk to move to the lateral side, leaving a clear opening through which the fundus could at once be seen. The fellow-eye was operated upon in the same manner, with a like result.

This rare type is described by Collins to be due to a failure of development of the nucleus of the lens, so that the anterior and posterior capsules are joined by a short strand of laminated tissue. There is an imperfect development of the cortical layers, the whole lens presenting in section a dumbbell shape.

Reference was made to the report of a case by the author, in 1910, in which the procedure, suggested by Collins, of flaking-off the opaque disk was followed, but it fell into the posterior chamber. A severe iridocyclitis followed, which may have resulted from the presence of the foreign body in this position.

Neurofibroma of the Orbit; Operation; Pathological Report

Dr. G. E. deSchweinitz and Dr. B. F. Baer, Jr., described a tumor situated in the lower and outer quadrant of the orbit of a man, aged thirty-six years, which was noted about one year prior to operation. This was performed by Dr. Baer. An incision 1½ inches in length was made through the skin, parallel to the lower orbital rim, and about ¼ inch above it. The growth was readily dissected from its bed and was not closely adherent to any of the tissues. Healing was uneventful. Exophthalmos (26 mm. Hertel's exophthalmometer) subsided, and the ocular rotations returned to normal.

Three years after the operation, the position, rotations and functions of the eye were normal; no sign of recurrence *in loco;* none of any growth elsewhere in the body.

Microscopic examination of the neoplasm revealed the structure of a neurofibroma. This pathological diagnosis was confirmed by Dr. Verhoeff.

Concerning Pseudo-optic Neuritis

Dr. G. E. deSchweinitz, after a brief review of the literature pertaining to the subject, agree with those authors who objected to the term "hyperopic disk," because the degree of hyperopia bears no relation to this anomaly, and because it may be evident in emmetropic eyes (as Spicer proved), and furthermore, it is reported to have been observed in association with myopia. "Pseudoneuritis" or "spurious optic neuritis" is the better descriptive title.

Statistical tabulations as to the frequency of pseudoneuritis vary considerably. Thus, Bristowe and Stephenson reported finding this manifestation in about 23 per cent of the eyes they had examined, while Nottbeck records only 0.214 per cent. Evidently, as C. G. Russ Wood points out, the first-named authors included in their lists "very slight cases," while Nottbeck utilized only well-marked conditions.

Dr. deSchweinitz expressed the opinion that many "slight cases" do not belong in the category of pseudoneuritis, but represent the phenomenon of the so-called "eye-strain" fundus.

Four types of pseudoneuritis were commonly observed: (*a*) disks over-red or grayish-red, their margins veiled or hidden, especially on the nasal side, but often also above, below and on the temporal edges, blending with the surrounding area of fine grayish lines and minute arterioles ordinarily invisible; (*b*) somewhat similar appearance, associated with what Fuchs describes as a cloudy-gray areola about the disk, and with either of these types the veins may be tortuous and the perivascular lymph sheathes unduly prominent in the form of white lines along the central vessels, especially the veins; (*c*) or a prominent feature may be the disk is covered with and obscured by a layer which blurs the margins and gives the impression of a transparent, injected, edematous tissue; (*d*) or the disk, entirely obscured, may be somewhat mound-shaped, elevated, or a marked grayish color, very similar in appearance to a late or subsiding stage of papillitis or papilledema.

Although a prominent and nonprominent variety of the disorder is described, he agreed with E. von Hippel that all forms of pseudoneuritis portray prominence or elevation, sometimes slight, sometimes pronounced, and a definite decision in this respect can always be reached by employing the binocular Gullstrand stereoscopic ophthalmoscope.

Additional well-known distinguishing features of pseudoneuritis are: absence of general symptoms; absence of any lesions of the eye-ground except those which pertain to the disk; normal corrected vision, unless there is congenital amblyopia; and an unchanging fundus picture, and, as Bartels maintains, if a similar state of affairs is found in the immediate members of the patient's family, the diagnosis of pseudo-optic neuritis is definitely established.

Dr. deSchweinitz referred to the fact that a number of patients with pseudo-optic neuritis had been under observation for one, two, three, indeed as many as ten, years, without revealing the slightest change in the nerve-head picture, and that elevations of the disk of three diopters or more had been noted.

But it is also a fact, he said, that true papilledema or papillitis occasionally remains unchanged for a long period of time, and moreover, cases are on record, the diagnosis having been "pseudoneuritis," in which ultimately general symptoms developed and tumor of the brain was found.

Perimetric studies of the "blind-spot area" were, he said, conspicuous by their absence in the reported cases histories of this affection. In his experience, some so-called enlargement of the blind spot will always be found, but not an increasing one, and not one the disposition of which corresponds to the pericecal scotoma which develops as the result of a true papillitis or papilledema caused by increased intracranial pressure.

Anatomical examinations of the nerve-head presenting the appearances of pseudoneuritis were wanting, and therefore, as von Hippel has said, it is without profit to speculate as to the histology of such disks, although he is willing to suggest that the papilla and neighboring retina contain an unusual amount of glial tissue.

Dr. deSchweinitz referred to Heine's report of six sisters, all of whom exhibited papilledema (2 to 3 D.) in disposition, density and abnormal coloration indistinguishable from a genuine papilledema in the pathological sense of that term. These cases Heine classified as "Congenital familial papilledema," and justly maintained they should be separated from the pseudoneuritic group.

In summary, then, it seems there are: (1) a group of cases characterized by over-red, somewhat streaked disk-edges, etc., probably eye-strain manifestations, which may subside or improve after proper correction of the refractive error, and hence are not permanent and do not properly belong to the pseudoneuritic class; (2)

a group of cases not necessarily definitely related to refractive error, with manifestations which vary in disposition and degree and are permanent, the disks being definitely prominent, which are congenital in origin and which form the proper class of "pseudoneuritis," and may be found in members of the same family; (3) a group of cases exhibiting disk changes named "pseudopapilledema," which probably represent a persisting and perhaps congenital form of edema; (4) a congenital familial type of choked disk, or papilledema, which belongs in a class of its own.

All these types are most satisfactorily studied by means of the Gullstrand binocular ophthalmoscope, and an important aid in differential diagnosis is afforded by repeated careful perimetric investigation of the blind-spot area.

(The paper was illustrated by means of visual field charts, by microscopic slides of the normal nerve-head and of genuine papilledema, and by lantern slides of the eyegrounds of patients with pseudoneuritis and pseudopapilledema from his own collection and from case histories reported in the literature.)

Discussion. Dr. Luther C. Peter said that Dr. deSchweinitz had emphasized the two points which are most essential in the diagnosis of pseudoneuritis: first, the study by the Gullstrand ophthalmoscope; and, second, central visual-field studies. The use of the Gullstrand will help materially in separating pure types of pseudoneuritis from other forms of swelling of the disk. In making routine studies with the Gullstrand ophthalmoscope it is surprising how many disks there are which show definite elevation, an elevation which may not be discernible by the hand ophthalmoscope.

In field studies it is possible, as Dr. deSchweinitz has pointed out, that it may be necessary for us to change our beliefs to some extent. There is a definite difference between the blind spot in pseudoneuritis and genuine choked disk and in optic neuritis. If we were to include all the types of cases which Dr. deSchweinitz has shown, I am sure there would be some definite enlargements of the blind spots in some of the groups. The familial groups, especially, would show definite blind-spot enlargement. Perhaps it would be best, in this differentiation, to depend upon the constancy of the enlargement in pseudoneuritis if enlargement of the blind spot is present, and upon the increase in the enlargement when the optic-nerve disturbance is due to mechanical pressure or inflammation.

We are all very much indebted to Dr. deSchweinitz for his very comprehensive and lucid presentation of this subject.

Dr. George Schwarzkopf, of Atlantic City, N. J., said that, besides the binocular Gullstrand, perimetry in a dimmed room might help in the often difficult differential diagnosis. In beginning choked disk the blind spot is

enlarged more distinctly in dimmed illumination than in ordinary perimetry. This applies in lesser degree to the neuritis optica, where the lack of adaptation to dark is more pronounced (Behr, von Hippel); the pseudoneuritis does not show any of these symptoms.

The Newer Ophthalmic Lenses

Dr. Alfred Cowan pointed out that when a monocentric pencil of light falls obliquely on a spheric lens it emerges as an astigmatic pencil. Except in the case where the visual axis coincides with the principal axis of the correcting lens the eye always receives an astigmatic pencil, the astigmatism increasing, of course, with the degree of obliquity. The astigmatism due to the tilting may be entirely obliterated for centric pencils by properly placing the glass before the eye; but when, in a mobile eye, the whole aperture of the lens is used the condition becomes more complicated, inasmuch as then we have to deal with the astigmatism of oblique eccentric pencils. The astigmatism of oblique eccentric pencils is the only aberration in an ophthalmic lens which is considered serious enough to warrant special attention, the other aberrations in general being scarcely manifest.

Given the distance behind a lens of the required power, the thickness of the lens and the distance of the object, the astigmatism of oblique pencils can be almost entirely corrected out to the rim of an ordinary spectacle lens.

Tscherning, in 1908, basing his calculations on a point 25 mm. behind the lens and for parallel rays, has graphically shown how, by a certain coflexure or combination of back and front surfaces, the astigmatism of oblique pencils may be eliminated in a series of lenses from −20 to +7 diopters. He failed to take into consideration the thickness of the lens, but this is practically negligible in an ordinary ophthalmic lens.

In order to conform to Tscherning's curve, it would be necessary to have a different coflexure for every lens, and the power of each surface would need to run into three or more decimal places. Surfaces so accurate cannot be ground and, besides, it is impracticable from the standpoint of the manufacturer to grind different curves for every power, nor is this necessary for the requirements of an ophthalmic lens. A lens is only approximately correct at best.

The Punktal and Tillyer lenses, made from secret and patented

formulæ, are each claimed by their respective manufacturers to eliminate the astigmatism out to the margin of the lens. As a matter of fact, no one lens can be made to correct the astigmatism of oblique pencils for every eye, for every distance of the object and for every meridian of a cylinder.

In the first place, these lenses are all based on the assumption that the center of rotation is exactly 13 mm. behind the cornea and that the lens will be placed 12 mm. in front of the cornea. The position of the center of rotation is not the same in every eye, nor is the lens always placed exactly 12 mm. in front of the cornea. Second, the lens must be calculated for a fixed-object distance, and when the chosen distance is infinity the lens must be inaccurate before the accommodated eye. In the third place, this type of lens cannot be corrected for the two meridians of a spherocylinder, one or the other must be used in the calculation; and in bifocals, where there is still another power, the problem is still further complicated.

Since the formulæ from which these patented lenses are ground are not made public, I have had measured with a gauge the powers of the back surfaces of a series of lenses ranging from −6 to +6 diopters. This was done by Mr. Saille, of Wall & Ochs. Two lenses of each power of the Punktal and Tillyer forms were measured, and the thickness of each lens and the power of the back surface tabulated.

It will be seen in this table that there is quite a difference between the two types; so much so, that one is led to believe that both cannot possibly be the ideal. In quite a few instances there is a difference in thickness between two lenses of the same power, which is a fault in lenses supposed to be ground with such extreme precision. It will be seen that in the positive lenses of one series the powers of the back surfaces vary between −6.62 and −7.87, and in the other they vary between −5.15 and −6.37. Neither series, if represented graphically, would form a regular curve.

A study of Tscherning's curve will show that (considering the lens infinitely thin) the back surfaces in the convex lenses up to 7 diopters nearly approach −8.50 diopters, and it will also show that this curve is practically parallel with the line for the mi-coquille lenses (having a back surface of −6 diopters).

Southall calculated a point-focal lens of +6 diopters, having a back surface of −7.38546 diopters, which has an astigmatism of 0.00022 diopter at 30 degrees from the axis; the Punktal lens of the same power and at the same angle has an astigmatism of 0.03

diopter; and the mi-coquille at the same angle and of the same power has an astigmatism of 0.15 diopter. The mi-coquille lens of +6 diopters has 0.12 diopter more astigmatism near the margin of the lens than the Punktal lens of the same power. The astigmatic difference is 0.08 diopter between the Punktal and mi-coquille forms when the vertex of the power is +4 diopters, and in the +2 diopter lenses the difference is only 0.05 diopter. This is the amount of astigmatism for a deviation of 30 degrees, a position that is not maintained with comfort. Very few, if any, spectacle wearers use an angle of more than 20 degrees, at which the astigmatism of oblique pencils by a lens with a base curve of −6 diopters may be considered negligible.

Now, since even the most carefully designed lens must vary from the theoretical requirements for an ideal lens, and since the difference, after all, is so small, there is no doubt that positive lenses up to 7 diopters, given a base curve of −6 diopters, will practically answer every pupose of a point-focal lens.

Presentation of Littell's Manual

Dr. Burton Chance, in presenting an exquisitely bound copy of an English edition of *A Manual of Diseases of the Eye*, by S. Littell, published in London in 1838, which he had picked up in an old-book shop, stated that Littell's *Manual* was the third, only, systematic work in ophthalmology published in America, and that it was a great tribute to the excellence of American practitioners that it should have been deemed worthy of an edition for the English.

Squier Littell was born in 1803, and died in 1886, at the end of a long period of retirement. In 1834 he was appointed on the staff of the Wills Hospital, Philadelphia, when that hospital was organized. He served there for thirty years; when his son-in-law, Dr. Douglass Hall, was taken on, he too served for thirty years, a continuous devotion by one family for sixty years. Littell wrote much in those days, of especial interest being an account of the newly established Wills Hospital for the Blind and Lame, and a description of the important cases treated in his first term of service. His chief ophthalmological publications were written before the ophthalmoscope was discovered. His *Manual* was given another American edition in 1846. Littell refused to be called a "specialist," his practice included whatever presented. He would not believe in the

malarial origin of disease nor accept the doctrines concerning vaccination. He strenuously opposed the admission of women into the practice of medicine.

In addition to his scientific writings, he wrote much for the religious press, being a devoted member of the Episcopal Church, and he was an authority on liturgics and hymnology.

MARCH 15

An Unusual Case of Persistent Pupillary Membrane

Dr. Thomas B. Holloway and Dr. Alfred Cowan presented the following case: A. M., aged sixty-four years, came into the eye dispensary of the University Hospital on February 28, 1928, for the removal of pterygiæ. Vision, O.D., 5/9; O.S., 5/9 cc.

In the right eye there was a broad, thin, internal pterygium extending about 2 mm. onto the cornea. There was a complete arcus senilis. By oblique illumination there can be seen several tiny brownish precipitates on the posterior surface of the cornea near the center. On the anterior surface of the lens may be seen thin grayish opacities in a circular arrangement, with a broad, irregular area, coming from under the pupillary margin between ten and eleven. The movements of the iris are free.

In the left eye was a broad, flat pterygium and arcus senilis, as in the right eye. With oblique illumination, two discreet brownish opacities could be seen near the center of the cornea. The anterior surface of the lens was similar to that of the right eye, but the circle was surrounded by a broader area on the temporal side and the whole design lay in the pupillary space.

In both eyes with the slitlamp could be seen several grayish deposits near the center of the posterior surface of the cornea, with several tiny brown pigment tags attached, possibly the remains of pupillary membrane. There were numerous punctate pigment deposits more or less scattered over the whole posterior surface. The aqueous and iris showed no abnormalities. The deposit on the anterior surface of the lens was of a thin, membranous nature with many of the edges free and extending into the anterior chamber. To quite a few of these were attached tiny tags of brown pigment.

The larger areas of adherent membrane seemed to be composed of tiny white dots. In the center of the pupillary space were numerous brown pigment remains in the form of clumps. None were of the star-shaped variety.

By retroillumination only the pigmented portions of the membrane appeared opaque. With the narrow slit it could be seen that the membrane lay on the anterior capsule, which was everywhere intact.

Senile Cataract. With a Consideration of the Accompanying Changes in the Lens Proteins

Dr. I. S. Tassman said that by fractioning the proteins of normal lens, according to the classification of Moerner, Jess showed that the water-soluble alpha and beta crystallins, because of their supposed cystein content, were responsible for the production of the nitroprusside reaction in normal lens. This reaction, described earlier by Arnold, was produced by extracts of certain organs where active metabolism takes place, by adding a few drops of a 5 per cent solution of sodium nitroprusside and a slight excess of ammonia, a bright, purple-red color resulting resembling that of permanganate. This reaction could not be obtained with the abnormal cataractous lens, except in its unaffected parts. It was therefore deduced by Jess and others that the alpha and beta crystallins were not present in the cataractous lens, and therefore the cystein, which was considered the important constituent in the production of the reaction, was missing in the cataractous lens. Cystein, an amino-acid, which, in the presence of oxygen, forms cystine by two of its molecules uniting, with the liberation of their hydrogen atoms. Cystine in the presence of iron is again reduced back to the original form of cystein. It was later shown by Hopkins that this auto-oxidizable constituent in the cell is a combination of cystein and glutamic acid, a dipeptide which he called glutathione, and which had the same oxidizable-reduction properties attributed to cystein.

Applying the N.P.R. as a guide, Abderholden and Wertheim showed that high temperatures accelerated the oxidation of cystein to cystine, with which the reaction is negative. Potassium permanganate was shown to retard the oxidation, while ultraviolet light had no effect. Iron was shown to hasten the oxidation. Jess, in experimenting with ultraviolet light on the lens, showed that the

N.P.R. was positive in lenses exposed to the rays just as in unrayed lenses, so that the oxidation was not affected.

In a later analysis of the normal lens, Jess showed that the two crystallins which predominate in youth decrease in amount with age, accompanied by a corresponding increase of the insoluble albumoid portion of the lens protein. In analyzing cataractous lenses he showed that there was a decrease in the lens weight, which took place by a reduction in the water content, as well as in the total protein content, but that the reduction in water exceeded that of the total protein reduction. The reduction in total protein took place almost entirely in the soluble alpha and beta crystallins, while the insoluble albuminoid portion was increased in amount. Fat, cholesterin and lecithin were practically unchanged.

Of the theories advanced from time to time for the explanation of the genesis of senile cataract, some attributed it for a time to a strictly local cause in the lens, while other included a constitutional disturbance. The question of the lens nutrition and osmosis is an important factor in nearly all. The possibility of deleterious substances entering from the blood, the permeability of the lens capsule, and the initial cell destruction are all considered. Jess referred to the possibility of a proteolytic ferment, mentioned by Goldschmidt, being released with the initial cell death and going on to destroy neighboring cells and fibers. As to whether the soluble crystallins leave the lens entirely in cataract or go over into the increased amount of the insoluble portion in another form is not yet established.

The discovery of Uhlenhuth of the organ specificity of the lens was followed more recently by immunological investigations and the preparation of various lens antigens and antiserums for the prevention of cataract. Recently, Alan Woods told of producing serologically pure fractional entigens of the lens. These preparations showed the same organ specificity of Uhlenhuth. Moreover, the alpha entigen showed an apparent protective action on the beta preparation, preventing the spontaneous precipitation of the latter. With the removal of the alpha entigen, the beta undergoes spontaneous precipitation.

The disappearance of the two crystallins from the lens stands out as a prominent factor accompanying the formation of senile cataract. Because of their high sulphur content and because of the presence of the N.P.R. in the normal lens and its absence in the cataractous lens, a further study of the structural units of the lens proteins and

their distribution in the normal and diseased lens will no doubt further our knowledge of the subject.

Three Cases of Cavernous Sinus Thrombosis (?), with Recovery of One Case Complicated by Pulsating Exophthalmos

Dr. Luther C. Peter stated that his first case occurred in a priest, forty-six years of age, in which the etiological factor was a much-lowered vitality from overwork, and probably a small central pneumonia. The blood culture showed the presence of a pneumococcus. The patient had the clinical symptoms of proptosis, limitation of movement, disturbance of the nerve head and blurring of vision, first in one eye and then in the other, accompanied by a hectic temperature, some delirium, cough and expectoration. The case cleared after about four weeks. The medication consisted of supportive measure and the free use of Pregl's solution intravenously. This first case belongs to the marantic group.

The second case was one which Eagleton classifies as "parietal thrombophlebitis." It occurred in a man, fifty-nine years of age, with a bizarre history of giant urticaria and other toxic symptoms for two years past. The first symptoms noticed were chemosis of the conjunctiva and swelling of the lids, first in the right eye and then in the left. The temperature ran high; the white-cell count was 20,500 with 97 per cent P.N.; and the nasal examination revealed the presence of chronic hyperplastic sinusitis with necrosis, especially on the left side. Following the sinus operation by Dr. Ridpath, the case made an uneventful recovery in about four weeks. There remained at this time but slight limitation of movement of the left eye to the outer side and conjunctival redness. The blood culture was negative.

The third case was a woman, sixty-eight years of age. She had a history of cardiovascular-renal disease, and developed the usual signs of cavernous sinus thrombosis, first in the right eye and then in the left, with a remission in the right. In addition, there developed a pronounced exophthalmos in the left eye, with a definite, palpable pulsation and a bruit synchronous with the systolic beat. The white-cell count was 18,500, and the blood culture showed the presence of staphylococci. The blood-pressure was 200 mm. Hg. The patient was paralyzed for several weeks. The examination of

the sinuses by Dr. Ridpath showed the presence of chronic disease of the sphenoids on both sides.

With the development of necrosis of the left cornea, the left eye was enucleated. An alarming hemorrhage from a dilated superior temporal ophthalmic vein was controlled by pressure against the bony orbit. The orbit was packed. Five days later a phlegmon well back in the orbit was curetted, and definite communication with the posterior ethmoids was uncovered. In addition, the nasal sinuses were drained through the nose. Following these operations, the patient made a slow and uneventful recovery. Three months after the onset, motility had returned to the right eye, with, however, some limitation of movement externally. In addition, the patient presented occlusion of the right superior temporal artery, a photograph of which was presented with the corresponding defect in the field.

Points of interest in the third case were the influence of the enucleation upon the recovery and the pulsating exophthalmos. Enucleation is indicated as a means of approach to drain the cavernous sinuses through the apex of the orbit, to relieve a phlegmon of the orbit and to ligate varicose ophthalmic veins. Attention was called to the pulsating exophthalmos, which was not due to arteriovenous communication in the sinus, but to the engorgement of the orbital veins. By enucleation and contraction of the orbital veins the pulsating exophthalmos entirely disappeared. The need for early operation, daily blood counts and blood cultures, and the use of Pregl's solution or other bactericides, are the important factors in recoveries from this disease.

Discussion. Dr. Edward A. Shumway congratulated Dr. Peter on the successful outcome of his cases. He had never seen a case of true cavernous sinus thrombosis recover. In one patient at the Philadelphia General Hospital, Dr. Fielding Lewis proposed enucleation of one eyeball and entrance into the sinus by way of the posterior wall of the orbit, but operation had been refused by the patient's family, and the man died.

Dr. Warren S. Reese thought that Dr. Peter had been unusually fortunate in the outcome of these cases. He stated that he had reported 2 cases of cavernous sinus thrombosis before the Section in 1921. Both of these patients died. Autopsy was secured in 1 case and the diagnosis confirmed.

A baby was recently admitted to Wills Hospital with marked swelling of the lids of the left eye. Within two days the right lids became swollen, and he made a diagnosis of cavernous sinus thrombosis. Pus was then obtained from the left orbit and the child went on to recovery. Evidently, the

swelling of the right lids was of the type transmitted across the nose, although it did not appear to be such clinically.

Cavernous sinus thrombosis and pulsating exophthalmos seem incompatible. It is quite generally accepted that the pulsation in pulsating exophthalmos is transmitted from the internal carotid artery through the cavernous sinus, back to the veins of the orbit. If the cavernous sinus were thrombosed, this pulsation would be cut off. It seems impossible that such a pulsation could be transmitted by contiguity of tissue in this region.

Dr. Frederick Krauss stated that he had seen a number of cases such as described by Dr. Peter, in which he felt that the exophthalmos and immobility of the eye and the chemosis of the lids were in the nature of an inflammatory edema, rather than a true thrombosis of the cavernous sinus. It is, however, a dangerous condition.

Dr. Krauss operated immediately in these cases by the external sinus operation method, and usually found a drop or two of pus over the os planum, in the neighborhood of the ethmoid vessels at their point of exit and entrance into the orbit. He usually found a carious spot in the bone in this region. The os planum is very thin and free drainage is readily established into the nose. In using the curette, care must be exercised to stay below the level of the anterior and posterior ethmoidal vessels. The operated cases always get well in a few days, usually with perfect restoration of muscle function.

Dr. Peter, in closing the discussion, expressed his personal appreciation to Dr. Eagleton for his courtesy in coming to the meeting to discuss these cases.

Dr. Krauss' attention was called to the special classification by Dr. Eagleton of parietal thrombophlebitis, in which the osseous walls and the fibrous coat of the sinuses are primarily involved. A thrombosis is arrested by removal of nearby necrotic areas in the nasal sinuses. The cases to which Dr. Krauss referred undoubtedly belong to this group, if the cases were bilateral and not unilateral cases, in which the orbit is involved from the ethmoid sinuses.

Lantern Slides from Uncommon Fundus Photographs

Dr. Arthur J. Bedell, of Albany, N. Y. (by invitation), showed some uncommon and unique fundus pictures selected from more than 4000 photographs which were gathered together and presented under various subdivisions. The first included sclerosis of the retinal arteries, sclerosis of the choroidal vessels, embolism, thrombosis and several forms of retinal, preretinal and vitreous hemorrhages. Some of these extravasations were associated with exudate, but in others there were no inflammatory reactions.

The most striking photograph was one in which the nerve head was a mass of tangled, thin, newformed vessels lying over an extensive

exudate. There was a large, superficial, oval clot, also a globular hemorrhage, which projected several millimeters into the vitreous. Retinitis proliferans was demonstrable on the nasal side of the blood mass.

In the second group was a photograph of the fundus in an interstitial nephritis, showing rounded hemorrhages distributed in the anterior layers of the retina, with marked increase of the arterial reflex.

The importance of multiple photographs to illustrate the lesions was demonstrated by means of two pictures: one, of the central region in which there was considerable superficial exudate; the other, the periphery of the fundus, which showed a massive white exudate. These could not be taken on a single plate. The organization of exudate combined with sclerosed arteries and tortuous vessels was presented.

Examples of pipestem arteries were exhibited. An unusual case was one of angioid streaks, in which white lines criss-crossed the center of the fundus with many plaques of dense pigment anterior to them. The nerve was pale, the vessels small.

The massive exudates were illustrated by three slides; two of them were the typical combination of diabetes with nephritis; the other was in a patient with low arterial tension.

From his collection of retinitis circinata, four were shown; one, an incomplete ring; another, a triple wreath; and the other, two complete classical circles of flocculent exudate surrounding a gray, degenerated macula. Especial emphasis was laid on the lack of connection between retinitis circinata and diabetes, nephritis or lues, although the cases reported included these constitutional diseases.

After discussing the gross retinal changes, photographs of lesions in and about the macular region—vascular, traumatic, and congenital—were thrown on the screen. These included a circulatory hole in the macular region; a dense white plaque of exudate about a dark, macular ovoid; an unusuallly large traumatic hole encircled by a wide zone of depigmented retina; a coloboma of choroid, and an inferior horizontal rupture of the choroid. A subretinal hemorrhage was photographed when it first became evident and after a period of treatment. The contrasting views explained the improvement in the symptoms. A few cases of choroiditis were demonstrated: one, with multiple tuberculous lesions; another, a large, healed, central tubercle, and still another of very extensive tuberculous involve-

ment of the macular region taken a few days before the death of the patient. A choroidal metastasis from glioma of the brain was one of the uncommon pictures.

Thirteen slides were used to illustrate the syphilitic changes in the fundus: among these was an acute choroiditis showing the indefinite outline of the acute lesion, and a later picture when the process was quiet and the scar pigmented. He also showed the small depigmented areas in a quiescent choroiditis and the complete destruction of the choroid in a patient who had been observed for many years, as well as the closure of a luetic vessel, first in the stage of retinal edema, and then after its subsidence. Perhaps the most unusual group were those in which neuroretinitis was marked, and the value of photography best illustrated by the comparison of the picture before and after treatment. In this series was a typical retinitis circinata with extreme specific arteritis, and a large oval mass of preretinal blood.

The edema of the retina following a severe contusion was beautifully shown with a cherry-red macular spot and two superficial retinal hemorrhages. The progress in retinal detachment was explained by two slides of the same patient. A wonderful curtain of separated retina made a striking picture on the screen.

He had selected only one case of retinitis proliferans, but in that the strands came from the disk to a large area of destroyed choroid. Retinitis pigmentosa, because of the gray retina, was said to be a difficult subject for photographic reproduction. Two cases were reported, the posterior pole in both and the periphery in one. The peripheral view was the one of greatest interest, because it showed the extreme deposition of pigment with a depigmented area near a vessel and a tabular black sheath about the vessel wall, similar to that seen in congenital lues.

Cystic degeneration of the retina associated with an acute retinitis was illustrated by three slides. A large cyst in the extreme lower outer field was outlined by fresh blood along its upper margin. This came from a degenerated, atrophic, pale choroid.

The last few slides called attention to the photographs of the nerve head by means of a hyperopic elevated disk, a collection of drusen, a choked disk, a papillitic atrophy after brain tumor, and an optic atrophy following a vascular papillitis.

Discussion. Dr. Luther C. Peter observed that Dr. Bedell's presentation, as usual, speaks for itself. He wished, however, to stress two points

which Dr. Bedell mentioned, namely, the value of fundus photography in making faithful records from week to week of the progress of cases; and second, the value of being able to show patients definitely that their condition is improving, which only this method of photography makes possible.

Measurements of the Blood-free Area of the Retina

Dr. Francis Heed Adler, with J. S. Sperling and H. Miller (by invitation), explained that the entoscopic method of studying the retinal circulation was used for the measurement of the blood-free area of the macula in a series of normal eyes. It was found that in a great majority the diameter of the macula free from capillaries was 0.4 to 0.5 mm., which is in agreement with the figures found by injection and histological examination of the capillaries. The difference in the size of this area in the two eyes of the same individual was usually less than 0.05 mm.

This study was undertaken in the hope that some change in the retinal circulation might be found in amblyopic eyes which could account for the poor vision, *i. e.*, an encroachment of the capillaries on the foveal cones. Although only one amblyopic eye was examined, this did not show any great departure from the normal. Further, in one normal individual with normal vision there was practically no capillary-free area in either eye. The method may have some use in the examination of patients with vascular changes and poor central vision without evident fundus pathology.

APRIL 19

An Interesting Fundus Condition of Obscure Origin

Dr. L. Waller Deichler reported the following case, which was first seen by him on February 29, 1928: Miss C. W. E., aged forty years, single, by occupation a filing clerk, gave the history of having had attacks of articular rheumatism since eighteen years of age, with a severe attack in 1918, which confined her to bed for five weeks. The tonsils were found diseased and removed at that time.

She had been wearing glasses for the past twenty years, with the last reëxamination in May, 1927, at which time she noticed marked blurring of vision, especially on near effort, but no change was made in the glasses.

She was advised to have a thorough medical examination, which was negative for teeth, sinuses, urine and blood analysis, including Wassermann. In December, 1927, however, two abscessed teeth were discovered and extracted.

In 1908 she was told she had white crystal deposits in the back of her eyes, as a result of some kidney disturbance, but was not confined to the house at this time.

Examination. Vision, 20/50 pt., unimproved with correction of + .50 s. + 0.25 cx 90°. L. 20/70, + .25 s. + .25 cx 90°.

Patient markedly anemic, with yellowish tint to the skin suggesting the pernicious type. Slight ptosis of upper lid of O.S. Lids and lacrimal apparatus negative. Palpebral conjunctiva anemic, with few enlarged follicles near the periphery of the lid. Slight divergent strabismus in O.S. Cornea clear in both eyes. Anterior chambers normal. Pupils round, equal, with prompt reaction to light and accommodation, and good consensual reflex. Ocular movements normal. Tension normal in both eyes.

Ophthalmoscope. Right eye, fine vitreous haze. Disk margins and entire fundus slightly blurred. Narrow scleral ring. Nerve of good color. Capillaries prominent. Vessels normal, but arteries very small in comparison with the veins, so that the normal ratio is lost. In the retina, to the temporal side, there are a few yellowish-white pinpoints producing a peculiar glistening retinal reflex, suggesting cholesterian deposits. The left eye agrees with the right, but cholesterin deposits are more numerous and this peculiar light reflex much more prominent than in the other eye.

Hometropine refraction, full correction: O.D. + 0.25 cx 90°. O.S. + 0.25 s. + 0.25 cx 90° produced no improvement in sight in either eye.

March 3, 1928. Fields taken, and show a marked contraction of form and color fields in each eye, and a tendency to binasal hemianopsia. O.S. much more involved than O.D., with absolute scotomata in the region of the blind spot. O.D., no scotomata. No additional demonstration changes noted in the fundus.

March 6, 1928. Admitted to the hospital for general study, where she remained until March 22, 1928, during which time urinalysis showed a trace of albumin, few granular casts, but subsequent urinalysis was negative. Blood: 3,900,000 red blood cells; 8200 white blood cells, with a differential count of 70 per cent polymorphonuclear and 30 per cent lymphocytes, with no nucleated reds.

Blood chemistry: blood-sugar, 91; urea, nitrogen 10, and Wassermann negative. Nose and throat examination negative.

X-ray of sinuses: No frontal sinus on right side; other sinuses negative. *X*-ray of head: Sella much shallower than normal; anterior clinoid normal, with apparent erosion of the dorsum sella. The floor of the sella is intact. Blood-pressure, 180/100. During this period repeated examinations revealed no demonstrated changes in the fundus.

March 13, 1928. Neurologic examination negative, with no demonstrable evidence of any pathology in the brain (Charles Potts).

March 21, 1928. No evidence of tumor. Diagnosis: essential hypertension (Fay). Fundus remains unchanged.

March 22, 1928. Discharged from the hospital.

March 24, 1928. Vision R., 20/70? L., 20/70?? Fields taken and show greater contracture of form and color in O.D. and for form in O.S. O.S. cutting is still much greater in the nasal field. O.D. fields round. Blood-pressure 156/96.

March 31, 1928. Complains that sight is becoming more blurred. Vision: O.D., 20/70??; O.S. 20/100. Fundus examination the same. Fields taken and are still smaller and more contracted both for form and color in each eye.

April 7, 1928. Has continued about the same. Admitted to the hospital today for blood-sugar tolerance test, which was normal both for blood and urine.

April 11, 1928. Vision: O.D., 20/70?; O.S. 20/200. Fundus the same.

April 13, 1928. Fields taken again today, and are much more contracted for form in O.S., but are slightly larger for both form and color in O.D.

April 18, 1928. Patient thinks the sight is slightly clearer. Can do her work with a little more ease. Vision: O.D., 20/70; O.S., 20/200.

April 19, 1928. Vision: O.D., 20/50 R I E B (P T E R); O.S., 20/100 O.E. (C B). The ophthalmoscope shows no demonstrable changes. Blood-pressure, 152/90. Fields slightly improved for form and color in each eye.

The case is presented because no conclusion could be reached as to diagnosis. Two ophthalmological consultations (March 9, 1928, and April 12, 1928) have confirmed the ophthalmological picture, but have not offered the diagnostic solution.

Discussion. Dr. deSchweinitz expressed the opinion, based, however, only on an opportunity for a brief examination of the patient, that the lesions, namely, a very fine so-called punctate hyalitis, distinct bilateral macular lesions and a probable low-grade chorioretinitis, suggest that the process is due to toxic influence not yet uncovered by the various examinations reported. Evidently a thorough search for a latent tuberculous focus, including an *x*-ray of the chest, is indicated, and he further advised colonic lavage, as intestinal sepsis might be an etiological factor. He was not clear whether the physician in charge had definitely determined the condition of the paranasal sinuses, especially the sphenoethmoid area.

A Case of Automobile Injury of the Eyelids and Orbit

Dr. Sidney L. Olsho (by invitation) reported the case of H. G., male, aged twenty-eight years, who was projected through an automobile windshield on February 24, 1928, receiving several lacerations of the face and circumorbital region, which were repaired by fourteen sutures at a New Jersey hospital. All of the wounds are now healed. Additional pieces of glass were dissected out on April 14, 1928, from the supraorbital region by Dr. Samuel Moss.

The patient presented himself at the Jefferson Hospital Clinic on April 19, and is of interest because of the movable mass in the region of the orbital process of the right malar bone, which might, because of its shape, be suspected of being a fracture of this portion of the orbital rim. A small sinus leads to the conjunctival sac near the right external canthus, but the skin surface in front of the mass is untraumatized. An *x*-ray plate, made today, leads us to suspect the presence of glass.

(A triangular piece of glass 2 x 1 x 1 inches was dissected out five days subsequent to the presentation of this patient.)

Quantative Pupillary Light Reflex

Dr. Louis Lehrfeld stated that some time ago his attention was attracted to the difference of opinion between two interns at the Philadelphia General Hospital as to whether a certain patient's pupils reacted to light. He was called upon to decide the issue in this case. He found that one resident, in testing his pupil-light reflex, was using a powerful pocket light, while the other had resorted to the use of faintly lighted bulb of his electric ophthalmoscope. Both observers were right, as the pupils reacted promptly to the strong light and reacted feebly, if at all, to the faint illumination.

This experience impressed him with the fact that we have no common basis of light intensity in determining accurately or uniformally the response of the pupil in light reactions. When we say the pupils react to light, we do not designate whether it is common daylight, focal illumination in a dark room, the light of a candle or that of a pocket electric light. It certainly makes a great deal of difference as to the intensity of the light used, and whether that light is projected onto the macula, nasal or temporal sections of the retina. The pencil of light from the slitlamp will often cause prompt reaction of the pupil, while that of the ophthalmoscope will give feeble reaction.

The point he wished to elucidate was not to advocate a new instrument, but to suggest a device that will give a standard candle-power of light upon which measure we can grade our strong, medium or feeble reactions, and which will be a basic measure for comparison, that the oculist or internist may make a fairly accurate record and have an intelligent understanding of each other's findings.

By using such a measure, case records will show whether the pupillary light reflex is waning or improving in response to the same amount of stimulus. The earliest manifestations of interference of the afferent light tracts may be noted and thus we can obtain information leading to the suspicion of early cerebrospinal disease. The Argyll-Robertson pupil might be detected earlier than under the present method of using any kind of light. Retinal diseases, affections of the optic nerve and the entire visual pathways, at least as far as the light pathways are known, may be detected or suspected early enough to warrant search for the cause.

In the selection of a standard basic candle-power of light to determine the pupil response there is a wide range of minimum and maximum intensity. The light which will cause a prompt reaction to the average normal eye (measuring an arbitrary average of one hundred eyes with normal vision and no pathological changes, and tested under varying degrees of daylight and darkness in the doctor's examining room) was arbitrarily selected at approximately 35 foot-candles at 1 inch from the eye. He stated that he might have selected 30 foot-candles or 36 foot-candles; but for experimental purposes, restricted by the manufacture of a suitable rheostat, he found that the average eye will give prompt reaction to a light of 35 foot-candles held 1 inch from the eye. What is meant by a prompt reaction is also a varying interpretation by each observer, but he

felt sure for demonstration purposes we can all agree as to the meaning of promptness.

He had an instrument prepared which will give three measurable amounts of light, 10 foot-candles, 35 foot-candles, and 50 foot-candles. A battery was selected that will give a 10 foot-candle light for seven hours before it begins to fail. After using the instrument for awhile one becomes accustomed to the minimum light of the instrument. As soon as it becomes dull the battery must be discarded. It can be used, however, for seven continuous hours before being rejected. In average office-work this may mean about two weeks. One is not testing the pupils continually, of course. If the pupil reacts to the minimum light the reaction may be designated as + 3; if it reacts to the 35, or medium light, and not to 10 foot-candles, + 2; if to the 50 foot-candles, only + 1; and if it does not react to the latter, it is negative, or regarded as inactive to light.

We measure Wassermann reactions as +1, 2, 3, 4, or negative, and knee-jerks as + 1, 2, or absent, and we designate choreiform movements as strong, moderate and weak; so in like manner we may measure pupillary light reactions. A common basis for comparison might thus be agreed upon. The instrument exhibited does not represent a refinement of measure, but it illustrates his point of the need of a common designation for pupillary light reflexes.

A Case of Involvement of the Orbit from Accessory Nasal Sinus Disease Closely Simulating Cavernous Sinus Thrombosis

Dr. H. Maxwell Langdon stated that thrombosis of the cavernous sinus is a condition so hopeless, in the majority of cases, that any condition which simulates it should be recorded for the sake of the differential diagnosis. The present case in its early stage, so strongly suggested the possibility of such a condition that it justifies this report:

Miss M. A. B., aged thirty-nine years, a schoolteacher, saw Dr. Leavitt on March 9, 1928, with the history that for two days previous she had suffered from symptoms of a grippe infection—headache, general malaise, chills, sore throat and coryza.

Examination showed a temperature of 102°, a profuse mucopurulent nasal discharge, an intensely congested throat with a purulent membrane in the pharynx which did not cover the faucial

tonsils. Culture of this was negative for diphtheria. Her temperature ranged between 99° and 102°.

On March 13, the patient complained of pain in the right side of the head, which seemed most intense in the right temporal region and in the distribution of the upper and middle branches of the right trifacial nerve. On March 14, there developed a paralysis of the third cranial nerve, with ptosis, outward deviation of the globe and some exophthalmos. There was no pulsation of the globe, but there was pain on pressure. Her temperature was 103°, with mental confusion and at times delirium. The leukocyte count was 10,050. She was taken to the Orthopædic Hospital, where she was seen by Dr. Wood and Dr. Langdon.

Dr. Wood's report, on March 16th, was as follows:

Left nasal fossa is free. Septum slightly deviated to the right. Right fossa is completely blocked by swollen turbinate, with much purulent secretion oozing between them and the septum. After shrinking with cocaine, most of the secretion was seen coming from under the middle turbinate. Thick, yellowish mucus in the pharynx was streaked with hemorrhagic mucus. Probable right ethmoid and antrum infection is present. Condition of the sphenoid could not be determined. Suspicious of orbital abscess.

Dr. Langdon on the same day reported:

The right lid is ptosed, but can be opened about 4 mm.; the eye is proptosed 4 mm. The globe is rotated outward, but can be moved slightly in all directions. Pupil is active, media clear, disk normal in color with some blurring of nasal margins, veins fuller, darker and more wavy than those of the left eye. Condition is either orbital cellulitis, abscess or thrombosis of the cavernous sinus.

X-ray examination by Dr. Bromer showed:

Definite increase in the density of the right antrum and ethmoid as compared with the left. The frontals are small, but seem to be clear. The naris on the right side is almost occluded by enlarged turbinates. There is no doubt of the infection of the right antrum and ethmoid.

Dr. Wood continued his intranasal treatment and washed out the antrum twice through intranasal puncture, but no formal operative work was done. There was steady and rapid improvement. By March 19, four days after the severe onset of ocular symptoms, the ptosis of the right lid and the exophthalmos had almost dis-

appeared. There was still slight loss of upward rotation, with some diplopia in the upper field. Other rotations were full, with no diplopia elsewhere. The fundus picture was unchanged.

On March 21, there was complete absence of diplopia and the retinal veins of the right eye were less engorged.

A note of Dr. Wood's on March 23 is: "Washed some pus from the right antrum." She has made a complete recovery.

For twenty-four hours it was an open question, with the chances about evenly divided, as to whether the condition was the early stage of a cavernous sinus thrombosis or not. The only definite sign of such a condition which was not present was an edematous condition over the right mastoid, and this sign is not always present early. She did have all the local intra- and extraocular signs, and, in addition, the temperature, sudden onset after an infection and the mental perturbation.

Discussion. Dr. William Zentmayer said that only recently he had been asked to see a man who had rapidly developed a proptosis of the left eye with annoying diplopia.

For lack of proper facilities a complete study was impossible. There was a marked limitation of all but the downward excursions of the eye, more particularly of outward rotation. There was no spontaneous pain, but this could be induced by backward pressure on the eyeball. The patient stated that he was awakened many times at night for some time past because of a drainage of secretion into his throat.

His doctor was advised to constrict the mucous membrane of the nose and introduce a tampon of argyrol and, as the condition was serious, to refer the patient to a rhinologist. It subsequently developed that the treatment was so efficacious that all the symptoms subsided in forty-eight hours and the patient had not yet been referred to the specialist.

Reference was made to a similar case, seen some years ago, in an infant in which the same treatment resulted in an almost immediate subsidence of the symptoms.

Dr G. E. deSchweinitz exhibited a few lantern slides depicting unilateral orbital cellulitis from ethmoid disease, unilateral thrombosis of the cavernous sinus, bilateral cavernous sinus thrombosis made from illustrations in an excellent article by J. Julian Chisolm and S. S. Watkins, entitled, "Twelve Cases of Thrombosis of the Cavernous Sinus," and a double orbital cellulitis due probably to an erysipelatous infection, from his own collection.

He called attention to the edema at the root of the nose and extending laterally in the sinus thrombosis patients, as compared with a similarly situated edema in orbital cellulitis cases, being in the former less defined and more diffuse than in the latter. The difference in the character and disposition between the two types of edema was rather noticeable, but whether it was a constant or even frequent condition he was unable to state.

He referred to Langworthy's statement that there is some evidence that in cavernous sinus disease there may be early diplopia due to paresis of the trochlear, but he had no experience of his own in support of this observation. Only too often the condition is too far advanced at the first examination to determine this point. Early anesthesia of the cornea is evident in cavernous sinus disease, usually, if not always, associated with slight haze of the cornea, which soon deepens.

Dr. Langdon, in closing, said that he thought that Dr. deSchweinitz's differentiation of the edema of cavernous sinus thrombosis and orbital cellulitis was very interesting, and it was borne out in this case, as the tissues around the bridge of the nose did not at any time lose their sharp outline and become boggy, as Dr. deSchweinitz pointed out that cavernous sinus cases are apt to do.

When he saw the patient the motion of the eye was lost, and it was impossible to tell which nerve had been first involved.

The "Triple Light" as a Practical Method of Perimetric Illumination

Dr. L. Waller Deichler said that the importance of the practice of perimetry in the diagnosis of disease of the visual tracts and of intraocular diseases needs no discussion. The practical use of the instrument requires: (1) Ideal illumination, *i. e.*, bright daylight, unclouded sky and northern exposure; (2) comparative study of the perimetric fields in any given case or series of cases further requires that these be taken under the same circumstances, *i. e.*, at the same hour of the day and with the same degree of illumination.

These ideals, impossible of realization, have stimulated a search for a type of artificial illumination constant at all times, of simple construction, easily installed, readily applied to the perimeter you already possess, conveniently manipulated and, finally, absolutely eliminating all shadows. The "Triple Light" is, therefore, presented for your approval because it has fulfilled each of these requirements.

It consists of three tubular reflectors, a type with which you are familiar, each one containing two 50-watt daylight bulbs, behind which is placed ribbed mirror reflectors, and in front of which is a diffusion glass screen. These tubular reflectors are arranged on a wood panel, one on each lateral side, suspended on arms extending fifteen inches from the panel, thirty-eight inches from the floor, and the third placed horizontally above, suspended on arms extending twenty-five inches from the panel. This arrangement gives an evenly balanced illumination.

The side reflectors are hinged for quick adjustment and for the convenient seating of the patient. The top reflector arms are jointed in the center to permit adjustment of the height of the reflector by raising or lowering the forward half. Each reflector may be rotated on its axis into the desired position.

Finally, in its application, the perimeter is placed in the center of the reflector space, nineteen inches from the wall, and adjusted at the level which gives the best illumination, *i. e.*, thirty-one and a half inches. This is permanent, The patient is seated just clear of the wall and positioned slightly to the right or left of the center to accord with the eye under observation, with the stool adjusted to the desired height. The shades are drawn, excluding all external light, and the room thus darkened, the light turned on by a single control switch, each lateral bracket so adjusted that the arm of the perimeter as it is carried through the lateral arc just clears the front of the lamp, while the beam of light, by turning the lamp, is directed across to strike the center of the arm, while in this lateral position, but on the opposite side, and that from the top lamp directed to strike the center of the perimeter at the point of fixation.

With these adjustments made, the degree of illumination, measured with a G. E. foot candle meter, gave the following readings: 30 at point of fixation and with the instrument held at 90+ on the arm.

28 at 180°	23 at 60°
25 at 150°	24 at 30°
25 at 120°	28 at 0°
23 at 90°	

The illustrations were taken in the desire to a better understanding of the appearance of the "Triple Light" at rest and in actual use.

The writer expressed his appreciation of Wall & Ochs for their assistance in the development of this equipment, and to the Lighting Service Department of the Philadelphia Electric Company for their aid in determining the adjustment of the source of illumination.

Discussion. Dr. George S. Crampton asked whether any measurement of the spectrum had been made to determine the color value in the illumination?

Dr. Deichler, in closing, said that his reason for presenting the "Triple Light" was because he had found it an extremely practical help in his work, and merely desired to pass it on to others. He realized full well that the ideal type of illumination is that attached to the bar of the perimeter,

shaded with a hood, so that it rotates with the arm as it is moved into the different positions; but this type calls for the expenditure of both considerable money and considerable time, and is designed more for scientific research than as a practical aid to the busy doctor.

In regard to Dr. Crampton's question, no attempt had been made to measure the spectrum and secure the color value in the illumination. He had been content to use the bulb which the General Electric Company advised as the closest approach that they have to daylight. He did not believe that this caused enough interference in the color value of the illumination to, in turn, destroy the color value of the test objects.

A Case of Occupational Toxic Amblyopia

Dr. William Zentmayer reported a case of toxic amblyopia in a man, aged forty-four years, a research worker in a large industrial plant. The family history was negative. Thorough clinical and laboratory study was negative except for a slight clouding of the ethmoids, but the direct examination showed no pathology.

He had for years been exposed to an atmosphere well laden with the fumes of benzol and methyl alcohol and more recently had worked on a moulding compound to which lead oxide was added.

There was a typical retrobulbar atrophy with a paracentral absolute scotoma approximating 15 degrees in size.

Inasmuch as it was only in his more recent work that lead oxide was used, and that the visual disturbance seems to date from this period, this may be the agent responsible for the amblyopia, especially as in the previous work others were equally exposed but unaffected, whereas in the latter work he alone was employed. This, however, is not conclusive, as in all toxic neuroses there is an individual susceptibility, and usually in lead amblyopia other well-known symptoms involving the peripheral nerves are found, while in this case they were not present.

The only conclusion possible is that the case is one of occupational amblyopia, and that in view of the exposure to several agents of known toxicity to the optic nerve, which one or more of these substances was the cause remains undetermined.

Retinal Disease with Massive Exudation

Dr. Perce De Long and Dr. W. G. Mengel (by invitation) made the following pathological report on a case of retinal disease with massive exudation:

Macroscopically. The globe was fixed in equal parts of Müller's and formaldehyde and prepared in the usual manner. The eye was divided horizontally which revealed a normal anterior chamber, the retina being detached and "V"-shaped, the detachment being caused by a serous exudate which occupied the greatest part of the vitreous chamber. The retina and other structures of the globe appeared normal.

Microscopically. The cornea, iris, ciliary body and lens were normal. The anterior chamber was partially filled with a serous exudate. The iris angle was obliterated by an anterior synechia, producing a secondary glaucoma.

The retina was markedly disorganized, and in certain areas there were new-formed fibrous-tissue masses in the different stages of organization. These were scattered throughout the retina, particularly peripherally, The new-formed fibrous tissue was located chiefly in the nuclear layers, but there were also many small areas found in the nerve-fiber layer.

The neuroglial supporting tissue was proliferated, and particularly in the area near the disk it formed rather thick strands in places. The ganglionic cells and the nuclear layers were fairly abundant, though much scattered. In the neuroglial trabeculi fibrous masses were also present. Scattered among this disorganized retina were many swollen cells, which are probably leukocytes. Some of them showed moderate evidences of degeneration. In certain areas the cell nuclei stained distinctly, and in others they were shrunken and crenated. In the peripheral portion of the retina there were many vascular changes. Some of the larger vessels, especially the veins, were enormously dilated. In certain places there were as many as six such vessels, lying close together. In other places they were isolated. Their walls showed some round-cell infiltration. There were some vessels, particularly the arteries and the smaller ones, which showed marked disease of the walls, the walls being very thick, showing few nuclei and having a more or less homogeneous appearance.

In many of the vessels the lumen was eccentrically placed and narrowed, and almost entirely obliterated. In certain areas these vessels were so numerous that many of them must have been new-formed. Some of the vessels showed distinctly that they had sac-like projections, which were probably aneurysmal dilatations. In other areas about the exudate and extending through the outer portions of the retina there were little vascular tufts.

On each side of the retina there was a detachment. The space was filled with a serous exudate in which there were numerous swollen cells. The nuclei were fairly well preserved. These cells contained very little pigment, but some of them contained brown granules. They were the so-called ghost cells, so frequently found in retinal exudates.

There were also many spaces in the exudate which were unquestionably cholesterin spaces. The choroid showed very little change, except to the temporal side there was a small area where there was infiltration and some thickening. Here the pigment epithelium was broken through, but otherwise it was intact.

The optic nerve was healthy.

OCTOBER 18

A Case of Leptothrix Infection of the Canaliculus

Dr. M. E. Marcove (by invitation) reported a case of this infection in a woman, aged thirty-five years. The early history was essentially negative, except that childhood was spent on a farm. For the past few years she has fed cows and chickens at home.

The condition started three years ago with lacrimation of the right eye. About a year ago the discharge became purulent, with pressure over the upper canaliculus causing a greenish-gray nodule, about the size of a pinhead, to be discharged from the upper punctum. This has continued, although routine treatment for sac infection has been carried out during this time, without avail.

Treatment consisted in slitting the upper canaliculus, with the expression of three small and one large concretion. The cavity was irrigated with a weak solution of potassium iodide. A weak solution of potassium iodide was also given by mouth. The condition was entirely cleared in one week.

Specimens were made by crushing the whole concretions upon a slide. The filaments composing the fungus showed very little branching, and were therefore considered leptothrix instead of streptothrix.

Discussion. Dr. Lewis P. Glover stated that, in connection with Dr. Marcove's case, there was one of a different type on Dr. Baer's service this spring. L. W., a Chinaman, working in a Chinatown restaurant, was

admitted, apparently having G. C. ophthalmia in both eyes. Upon staining the secretion, leptothrix was found. There was present a purulent secretion, closely resembling ophthalmia in the early stage. The bulbar and palpebral conjunctiva was studded with pinhead, yellow nodules, but the canaliculi were negative.

The secretion remained seropurulent for two weeks, but cleared up entirely with irrigations and instillations of potassium iodide solution 3 per cent.

No history could be obtained because of language difficulties.

Edema of the Conjunctiva with Rhinorrhea

Dr. Edward A. Shumway reported a case of edema of the conjunctiva associated with rhinorrhea (hyperesthetic rhinitis). The patient, a man, aged seventy-four years, had always been troubled with repeated attacks of coryza and was very sensitive to cold winds. He had also suffered from several attacks of dermatitis, which cleared up in southern climates. The present condition began about one year ago, in the wintertime, with sneezing, stuffiness of the nostrils and watering of the eyes, and persistent dropping of fluid from the nostrils, which at times was so profuse as to saturate his handkerchiefs.

Examination showed a marked edema of the conjunctiva, which surrounded the cornea like a cushion, and resembled an intense dionin reaction except that there was a pronounced pallor and little secretion. A nasal etiology being suspected, he was sent to Dr. James E. Landis, who reported that there was present a bilateral ethmoiditis, with hypertrophy of both inferior turbinates and a boggy appearance with overactivity of the mucus-producing cells, which caused him to have a rhinorrhea. His throat was practically negative. For the relief of the overproduction of mucus, he advised the use of Fowler's solution internally, two drops three times daily, and local treatment for the ethmoiditis.

The patient was also examined from a neurological viewpoint by Dr. C. A. Patten, who found a blood-pressure of 220/120, and suggested a study of the renal function and hypersensitivity to proteins. The urine examination revealed nothing except a low specific gravity (1006), a very faint trace of albumin, no sugar, diacetic acid or acetone. Protein tests were made by Dr. Albert Oliensis, and out of many tests he reacted only slightly to rye grass, sweet vernal grass and corn, and nothing in his diet caused indigestion with the exception of apple butter.

The patient was ordered a solution of "estivin" locally with a boric acid solution, and Fowler's solution internally. Under this treatment the ocular and nasal conditions had improved somewhat, the edema of the conjunctiva had lessened and the nasal secretion was much less marked.

Dr. Shumway discussed the causes of edema of the conjunctiva, quoting from Saemisch's article in the Graefe-Saemisch *Handbuch:* It can appear in connection with an acute conjunctivitis, especially of a blenorrheic or diphtheritic type; also in association with acute inflammation of the uveal tract, acute glaucoma and panophthalmitis. It is also produced by inflammatory products in the neighborhood of the eye, such as styes, acute dacryocystitis or periostitis of the orbital rim. It had been seen by Spicer in inflammation of the cervical glands and occurs in cerebrospinal meningitis. In old people it may be due to relaxation of the tissues, especially with Bright's disease, and may appear in anemia, chlorosis and exhausting diseases. It may follow perforation of the cornea by operation or traumatism, or in ulcer, where the opening is covered by conjunctiva. It has also been described in association with urticaria, and by deSchweinitz in two cases of facial neuralgia. It is an accompaniment often of sinusitis, frontal, central and ethmodial, and may be of the ordinary variety, or assume a recurrent, painful type, fugitive in character, and be associated with violent headache (deSchweinitz).

The association with rhinorrhea or hypersensitive rhinitis, as in the present case, has not been reported so far as I know. Dr. Landis, in his discussion, will take up this phase of the subject and give his explanation of the mechanism of the blocking of the lymph channels which has caused the edema.

Discussion. Dr. James E. Landis (by invitation) said: The question arises, what produces the rhinorrhea, and is there any association between this and the chemosis? The trifacial nerve has an inhibitory action on the glands of the mucous membrane, and in a palsy we have a rhinorrhea. This also occurs in either a stimulatory condition upon the ganglia of the cranial nerves, or a toxic irritation present in the sinuses affecting these ganglia, or in a blockage of the lymphatic flow due to swelling of the tissues from an infection present. I feel certain that the chemosis in both eyes has a direct relationship with the pathology occurring in the nose because we can eliminate trifacial palsy and the skin tests of different plant pollens and foods are practically negative.

The presence of infection in the ethmoid cells produces a toxic effect,

namely, a bacterial sensitization, upon the nervous control of the nose, the sphenopalatine ganglion. This irritation produces an overactivity of the mucus glands. The presence of a long-continued coryza has brought about a toxic effect upon the surrounding tissues and has infiltrated them with fibrous tissue and in this way has produced a blockage of the lymphatic drainage. The infection having extended through the thin, bony partition separating the ethmoid cells from the orbital cavity, has evidently caused a certain amount of fibrosis. This blockage has produced the stasis and chemosis; therefore, I believe that the bilateral ethmoiditis is the direct cause of both the chemosis and the rhinorrhea.

The question remains: Is a bilateral ethmoidectomy necessary in this type of case? If the patient had any optic nerve pathology, such as an optic atrophy papillitis or a chorioretinitis, I would suggest surgical procedure; but, due to the fact that the eye-grounds are negative and on account of the age of the patient, I feel that local treatment of the ethmoid cells will be sufficient to clear up the condition.

The bilateral ethmoiditis has evidently produced the bacterial sensitization affecting the sphenopalatine ganglion, causing the mucus discharge, and the toxic effect upon the tissues has produced the lymphatic stasis which, in turn, I believe has caused the associated chemosis. This comes under the term of a hyperesthetic rhinitis, which is differentiated from hayfever in that in hayfever we have positive skin tests to confirm the diagnosis and the condition occurs at a given time of the year, but in hyperesthetic rhinitis we have no reaction to skin tests and the condition is perennial.

There remains one other condition to be differentiated and that is cerebral rhinorrhea as brought out by Bosworth and later by Sir St. Clair Thomson. In that, in cases of pituitary tumor or dehiscence of the sphenoid, we have occasional seepage through of the cerebral fluid. This is differentiated by laboratory tests. Upon examination of the discharge in a case of cerebral rhinorrhea we have a reduction of Fehling's solution which we do not have in a mucus rhinorrhea, and in a rhinorrhea of nasal origin we have the presence of a large amount of mucin which we do not have in a cerebral rhinorrhea.

In closing, Dr. Shumway spoke of the causes of rhinorrhea reported by Priestly Smith, in which there was optic atrophy probably due to tumor of the pituitary body. In the present instance, however, the optic nerve was not involved, and the fluid from the nose could be readily shown to contain mucus and different, in its chemical reaction to Fehling's solution, from cerebrospinal fluid.

Infection of a Cataract Wound with a Facultative Anaërobic Streptococcus

Dr. H. Maxwell Langdon and Dr. H. M. Cobe (by invitation) reported that on January 6, 1928, M.B., a negro woman, aged sixty-eight years, came to the eye dispensary of the Presbyterian Hospital with the complaint that the vision of both eyes had been gradually

failing for several years. There had been no other symptoms than the failing vision.

Examination showed a vision capable of perception of light, with good projection in the right eye and 1/40 in the left eye. The right lens was completely hazed, with some anterior cortex not quite matured; the left lens showed posterior changes and nuclear haze sufficient to prevent a satisfactory view of the fundus.

Operation was advised and agreed to, on O.D. Cultures from the conjunctival secretions showed staphylococci aureus and albus, in spite of active treatment, until April 13, 1928, when they were sterile, and on April 15 she was admitted for operation the following day.

The usual preparation was made and a combined extraction was done without accident. The patient was well behaved and the lens was extracted without difficulty and with no loss of vitreous. The day after the operation the eye was comfortable and the dressing was not disturbed. Dr. J. M. Thorington changed the dressing on Wednesday the 18th, two days after the operation. He found the eye in good condition, quiet, with a closed wound and restored anterior chamber.

The following day the writer was told, on inquiry how she felt, that the eye had been painful since the evening before. Examination showed that the lids were puffy, with some secretion along the margin. The conjunctiva was found chemosed, with considerable grayish secretion; the wound open and its lips gray. The eye was well flushed with bichloride of mercury, the lips of the wound touched with silver nitrate. Cultures were made and an injection of 5 cc. of boiled milk was given without general reaction or influence upon the eye, and on the next day but one 10 cc. were given with a like lack of result. The cultures were sterile, as were those on the 21st and the 25th of the month, the fifth and ninth days after operation. In spite of treatment the eye became steadily worse and was enucleated on April 30, 1928, just two weeks after the first operation.

The following is Dr. Cobe's account of the bacteriological study:

Routinely, eye cultures are made from all conjunctivæ prior to operation. The usual air and surface organisms (Staphylococcus aureus, albus, etc.) are found. All these organisms grow easily on laboratory media, but occasionally an apparently sterile culture causes trouble, and the question of anaërobic organisms must always be borne in mind.

Bacteriologically, this case presents an interesting aspect, namely, the

problem of the detection of unusual infecting organisms with the usual laboratory media and technic. Chronologically, prior to operation, the conjunctival cultures showed growths of the usual surface organisms. Culture taken: February 3, showed Staphylococcus albus; February 30, were sterile; April 6, Staphylococcus albus in both eyes; April 8, the patient was admitted to the house. Cultures taken on admission were sterile. Stab cultures showed staphylococcus and the patient was discharged untreated on April 10. April 13, cultures were taken and reported sterile just prior to operation.

Patient was operated upon April 16, 1928. April 19 pus appeared and was cultured—result, sterile; 21st sterile; 25th sterile; 26th, was cultured aërobically and anaërobically under oil, and showed a Gram-positive diplococcus.

April 27, pus cultured under oil, showed a long chain streptococcus and Gram-positive diplococcus. Aërobic cultures were sterile. Pus cultured from the enulceated eye specimen and pus from the eye showed short chain nonhemolytic streptococci, few Gram-positive diplococci and some very occasional Micrococcus tetragenous; while direct smears from the eye specimen and the pus from the eye were negative for organisms, although loaded with pus. From a superficial infection at the outer angle of the orbit, pus showed the same streptococcus; morphologically and culturally the same.

A more detailed study of the streptococcus isolated was undertaken, and it was found at the same time that the colonies of the Gram-positive diplococcus were identical and that if the organism was allowed to grow out at a longer time it developed culturally and morphologically into the streptococcus. Under oil, there was no production of any appreciable amount of acid. Gas production, too, was slight, but definite and positive. Fermentation reactions were as follows: glucose, plus minus acid and gas; sucrose, + 3 gas; mannite, + 1 gas; lactose, plus minus about equal to glucose; xylose, negative. Culturally and fermentatively its reactions correspond to the Streptococcus mitior of Schotmüller or Streptococcus mitis of Herder.[1]

The stroptococcus was isolated anaërobically and planted aërobically in symbiosis with Bacillus subtilis. After the third generation of symbiotic growth the streptococcus could be carried along as streaked out on a blood plate. There was no hemolysis of the hemoglobin. The colony was not different in type from other nonhemolytic streptococci colonies, but differed from the pneumococcus colony. They were colorless on agar plates, round discreet, about 0.9 mm. in diameter. To be sure it was not a pneumococcus, bile solubility was done and the organisms did not dissolve.

Intraperitoneal guinea-pig inoculation produced a superficial abscess at the point of inoculation with 1½ cc. of a broth culture (pH 7.6). Apparently this was much less than a lethal dose, as the animal survived and showed very little systemic reaction.

Based on fermentation and cultural characteristics, therefore, we classify this as a nonhemolytic, facultative, anaërobic streptococcus, related to the Mitis or Mitior group.

[1] München. med. Wchnschr., 1903.

A Case of Myopia and Glaucoma with Unusual Visual-field Deformation; Cyclodialysis

The case history, reported by Dr. G. E. deSchweinitz, concerned itself with a colored man, aged thirty-one years, with myopia (−6.00 and −7.00 D.); chronic glaucoma, at the time of first examination deeply cupped disks of three years' duration; vision, R.E., 6/150; L.E., 6/60; intraöcular tension: right, 26 mm., left, 36 mm.—Schiötz tonometer; and unusual field defects, namely, nearly complete loss of each upper field above the horizontal meridian, save only a narrow, pointed, steeple-like area which passed upward on each side of the upper vertical meridian.

Cyclodialysis performed on the left eye was followed in a few hours by a sharp attack of acute rise of tension, promptly controlled by myotics. Four months later, cyclodialysis on the right eye and a temporary rise of tension of left, controlled by myotic; tension, O.D., 6½ (therefore subnormal); O.S., 21, and has remained so. The visual fields remained unchanged, and the direct vision about the same for at least four years, but then vision reduced to—right, 4/100; left, 6/100; some vitreous disorganization and moderate retinal perivasculitis.

During the next year the conditions were about the same, but the steeple-like preserved area in the upper field disappeared, and five years after the first examination and treatment there was, as is not uncommon in advanced glaucoma, complete superior hemianopsia. A point of therapeutic interest was that rises of tension after operation (cyclodialysis) were promptly controlled by myotics, and remained so; prior to operation the myotics were ineffectual.

Loss of Vision and Papilledema Caused by Excessive Uterine Hemorrhage

The patient whose clinical history Dr. deSchweinitz reported was a Russian woman on whom, when two months pregnant, a criminal abortion had been performed, followed by severe hemorrhage which continued for six days, when, preceded by violent headache, blindness (only light perception) occurred. The ophthalmoscope revealed very pallid disks, +4 D., narrow, pale arteries; full, dark veins. Gradually improvement took place, the disk edema subsided, leaving a pale nerve-head, and the vision three weeks after

the initial hemorrhage was R.E., shadows; L.E., 4/15. The field of vision presented the appearance of an impure binasal hemianopsia.

Dr. deSchweinitz made a brief reference to the history of these cases, the various ophthalmoscopic appearance, and to the visual field distortions, nasal defects having been found in about 4 per cent of the reported cases. He emphasized the well-known fact that such blindness very rarely occurs after a pure traumatic hemorrhage, and hence the belief that bleeding, *per se*, is not the sole etiological factor; a predisposing cause must be predicated—perhaps a lowered resistance due to a constitutional malady, or an undetermined toxemic influence. He discussed the various theories which have been advanced to explain the fundus lesions and the field defects. He pointed out that this affection had been observed in animals (horses).

A Recent Visit to the Barcelona Clinic of Dr. Ignacio Barraquer.

Dr. G. Oram Ring presented a paper upon "A Recent Visit to the Barcelona Clinic of Dr. Ignacio Barraquer."

After making a brief reference to the various approaches to, and to the charm of, the city itself, Dr. Ring detailed Dr. Barraquer's plans for establishing spring and fall ophthalmic courses to embrace both his public and private clinics.

Reference was made to the clinical work of the old Santa Cruz Hospital and to a new and wholly modern structure which is in the course of construction. Emphasis was placed upon the enormous number of trachoma cases seen at the public clinic, averaging quite fifty a day, and upon the method and good results of treatment in the acute cases. Dr. Ring detailed the treatment of chronic dacryocystitis by the method of stricturotomy and flexible probing, after the method of Poulard. The latter method is given preference and the results were regarded with satisfaction. One or two assistants devote all their time to such treatment.

Reference was made to a rare case in a child aged three years with a spontaneous dislocation of the crystalline lens, leuetic in origin, without traumatism. The details of the operation were given.

The use of the small Graefe knife in secondary lens opacities, and the use of the keratome and De Wecker scissors in the iridotomy procedure were contrasted with our own habit of using the V-shaped opening in the iris by the Ziegler method.

A unique and valuable trephine recently introduced by Dr. Barraquer for incising a section of cornea in a recently destroyed eye to replace a nebulous or leucomatous area was discussed, as having considerable promise. This will replace the Von Hipple procedure. The ingenious instrument combines the trephine and suction in one. The incised circle is 7 mm. at the outer corneal layer and 8 mm. at the inner layer. The treatment of serous detachment of the retina by suction placed over the sclera at the point of detachment was thought to be of promise.

The paper then detailed the operation of phacoeresis, as performed by Dr. Barraquer, and included a description of his operating environment, the light used, the method of preparation of the patient and the "bandage test" as contrasted with our own culture methods. The preparation of the patient and the details of operation, as modified since the original published description, were considered.

In closing, it was noted that there would soon be published a paper by Dr. Barraquer giving the results of one thousand consecutive extractions, which would permit the profession to accurately compare the results by this method with the better known and more generally practised procedures.

NOVEMBER 15

An Improved Retinoscope

Dr. George H. Cross, in exhibiting an improved retinoscope, said: "Dissatisfaction with my ability to see the pupillary shadow on the retina sharply and clearly induced me to first add a +1 sphere to the distant correction and wear such a pair of glasses only for retinoscopic work. This changing of glasses was a trouble and a nuisance, so, while examining an ordinary retinoscope, the idea was evolved that the +1 lens could be made a permanent par of the retinoscope and thus give one the pleasure and comfort of seeing clearly without making the apparatus at all cumbersome.

"The improvement in the retinoscope consists in the addition of a +1 lens, such as is used in the Loring ophthalmoscope, in a circular well drilled in the main plate of the instrument, directly over the hole in the plate and under the mirror, so that no extra ring or clamp

is necessary to hold the lens in place, this being accomplished when the mirror is fastened to the base plate. It is practically impossible to scratch or break the lens thus fully protected on both sides.

"This modification of the retinoscope will prove of great benefit and comfort to most refractionists past forty years of age who desire to see the pupillary shadow on the retina sharp and clear-cut, and have a much better idea of its various movements.

"The improvement can very easily be incorporated in the various electric retinoscopes as well as in the hand retinoscope. I am indebted to Messrs. McIntire, Magee & Brown Company for their aid in the mechanical construction of the instrument here shown."

Circinate Retinitis

Dr. Hunter W. Scarlett exhibited a case of circinate retinitis which had been observed for over eight months, during which time several changes were noted. The exudate had increased from a few discrete dots and two patches until a serrated semicircle beyond the macula was formed.

The patient's father, mother and one sister had died of tuberculosis

The patient had first noticed a disturbance of vision one month before coming to the Bryn Mawr Hospital dispensary for glasses.

Fuchs believed circinate retinitis was due to a fibrinous exudate into the retina, while De Wecker thought it was a fatty degeneration, following hemorrhage.

Discussion. Dr. Zentmayer exhibited a photograph of the fundus of a typical circinate retinitis taken by Dr. Alfred Cowan. The condition was bilateral. The patient was a woman about sixty years of age. The physical examination was negative.

Dr. Zentmayer stated that he knew of but two anatomical studies of circinate retinitis; the one usually quoted made by Amman in 1895. As this eye was the seat of pathology from other causes, some doubt has been cast upon the findings as they relate to circinate retinitis.

About two years ago, Morax reported concerning the microscopic pathology of circinate retinitis as found in an eye removed for pigmented epithelioma of the iris. He found far more microscopic changes than might be expected from the ophthalmoscopic changes.

The maxular lesion was due to a vacuole formation affecting the inner nuclear and the outer reticular layers.

The changes corresponding to the gross ophthalmoscopic picture of a circinate lesion were found to correspond to the exudates found in albuminuric retinitis. A few hemorrhages were found. The retinal vessels on the temporal side were sclerosed.

Aniridia

Dr. W. O. La Motte, of Wilmington, Del. (by invitation), reported the case of a white male, aged twenty-six years, who first came to him in January, 1922, complaining of poor vision and frequent pains over his eyes. Vision: O.D., 6/60; O.S., 6/45.

He was the oldest of seven children. One boy died at twenty-four years of age of tuberculosis, one at twenty-six years of age of typhoid fever; the other children, with the father and mother, were living and well. There was no history of other eye trouble in the family.

The eyes then were practically as they are now, with the exception of fewer corneal opacities which are now over the center of the left cornea, which reduces the vision of that eye to 2/60. Vision of the right eye is now 6/50, and with −0.5 sph. +1 cyl., axis 120 degrees vision is 6/40+. The irides, as far as can be seen, are entirely absent. There are stellate cataracts in the posterior cortical areas. The eye-grounds are not seen satisfactorily, but no gross changes can be made out. The tension of each eye is 28. There is spontaneous horizontal nystagums present.

He stated that deSchweinitz refers to aniridia (*Diseases of the Eye*, tenth edition) as "a complete detachment of the iris from its insertion," due to an injury. Fuchs refers to it in his *Text-book of Ophthalmology*, sixth edition, Duane's translation, in three lines, as follows: "The iris may be wanting altogether or all except a small residual portion. This defect is frequently complicated with congenital opacities in the cornea or in the lens." It is stated in the *American Encyclopedia of Ophthalmology* that "anatomical investigation always reveals a stump of iris even where clinically a diagnosis of complete aniridia has been made." It may be that such stumps are a factor in glaucoma, to which these eyes are supposed to be predisposed. Apparently, aniridia is very rare.

Prepapillary Retinal Vessel

Dr. John Siggens (by invitation) presented a case showing an anomalous retinal vessel which extended directly forward from the neighborhood of the disk into the vitreous for several millimeters, turning then upon itself and by several turns upon itself returned to the retinal level.

Discussion. Dr. Chance expressed his appreciation of the opportunity which Dr. Siggens had afforded in enabling us to see what must be an exceedingly rare anomaly. Besides this one he recalled having seen two others. The one while he was a house doctor at the Wills Hospital in the service of the late Dr. Keyser; and the second in the service of the late Dr. Fisher, in 1914. These vessels bear no relation to those sometimes seen with remnants of the canal of Cloquet.

Dr. Zentmayer, in corroborating what had been said as to the rarity of this anomaly, recalled but one well-marked instance seen in a colored man in which the appearance was that of a tightly-twisted, conical spiral. In most of the cases, and it is true of one of the two shown tonight, the vessel is sheathed with glial tissue giving off a brilliant reflex.

A Case for Diagnosis

Dr. Edward A. Shumway showed a case for diagnosis of supposed sarcoma of the neck, with double vision, in a healthy girl, aged sixteen years. Six weeks before examination, at the Oncological Hospital, she had had a cold with a bad sore-throat, on recovering from which she noticed double vision and a lump appeared back of the right sternocleidomastoid muscle in the neck, which was tender to pressure. She had been seen by a prominent Philadelphia surgeon and a diagnosis of sarcoma of the neck was given.

Examination found paresis of the left superior rectus muscle. (Later examinations showed the right inferior rectus muscle as the one involved.) (Later blood examinations showed no myelocytes, but 10 per cent of eosinophils.) The pupils were equal, responded actively and showed marked hippus. The eye-grounds were normal and the vision good. Examination by Dr. Off showed infected tonsils, but no sinus involvement. *X*-rays by Dr. Newcomet showed no clouding of any of them. Neurological examination by Dr. Potts found reflexes, gait, station and coördination entirely normal. There was a slight hypalgesia of the right half of the upper lip, probably due to recent extractions of teeth. Five teeth had been removed previous to admission, three of which showed root abscesses and one of them a large dentigerous cyst. The urine was normal, the Wassermann test negative, but the blood report made at the hospital (which was not entirely satisfactory) showed 2,700,000 red corpuscles, 7000 white corpuscles and a differential count of 50 per cent myelocytes against 30 per cent neutrophils and 20 lymphocytes. This examination was to be repeated at another laboratory, as the findings were contradictory. Examination of the chest and

abdomen were negative, and the spleen was not enlarged. The right side of the face was distinctly more prominent than the left, evidently partly due to asymmetry, and there was a difference of 2 mm. in the anteroposterior positions of the two eyes.

The case was presented for diagnosis, with a tentative diagnosis of a focal infection from the teeth and tonsils, which had resulted in an enlargement of the postcervical gland and a nuclear disturbance of the branch of the third nerve supplying the inferior oblique muscle. The prognosis from such a diagnosis would be much better than from the diagnosis of sarcoma and metastasis to the nucleus at the floor of the fourth ventricle. Further reports would be made if subsequent blood examinations show there is really an increase in myelocytes, which would make possible a diagnosis of myelogenous leukemia.

In closing, Dr. Shumway said, in answer to a question by Dr. Holloway, that there was no involvement of the lacrimal gland, and that an *x*-ray of the chest had not been made as there seemed to be no indication for it.

Pressure Atrophy; Reconstruction of a Generally Contracted Socket

Dr. Edmund B. Spaeth presented a case, from Dr. Peter's service at the Graduate Hospital, of pressure atrophy molding of a generally contracted socket.

The patient was a colored girl, aged fifteen years, who had lost her eye when an infant. The socket was unable to retain a prothesis. Plastic reconstruction of the socket by Thirsch grafts had been done. This had curled up after a period of four weeks into a light-brown-tinged, furrowed membrane.

A plaster of Paris skull cap was suggested by Dr. Robert H. Ivy. Above the right eye two C-shaped arms were embedded in the skull cap. At the distal end of these two arms a mold of gutta-percha was forced into the socket, the arms having sufficient spring, being made of German silver heavy wire, to maintain pressure of this mold in the socket, against its posterior and superior walls. The mold had been in place for a month. It is anticipated to continue the wearing of this mold for at least three months, and the mold itself to be increased in size two or three times during this period. The last four weeks the pressure is to remain unchanged.

Dr. Spaeth mentioned a series of cases in which the same procedure had been carried out by him, and with universally good results.

Retained Hyaloid Structure as a Cause of Juvenile Cataract; a Clinical Memorandum

Dr. William Zentmayer said that the thought to record these cases came from recently hearing an essayist say that monocular cataract in young individuals is practically always due to trauma. The two cases of juvenile monocular cataract here reported, and one other which he recalled but whose record he had not been able to find, had a different cause than injury. All three were associated with, and undoubtedly due to, the persistence of the central hyaloid artery.

A. C., a boy, aged twenty-one months, was seen in 1894. A cast and a reflex from the pupil had been noted by his physician soon after birth. A healthy child. Examination showed a persistent hyaloid artery, blood-bearing. In 1899, there was a practically complete cataract and, in 1903, the lens matter had undergone complete absorption and the retained hyaloid structure could again be seen extending forward, where it bifurcated, one branch being attached to the posterior capsule of the lens and the other could be traced forward to the oro serrata and was there lost.

The second case was a patient in the private practice of Dr. Posey, a boy who had been operated upon when two years of age for cataract. A white reflex of the pupil had been present at birth. At the age of six years the child was referred to me by Dr. Swindells because of an esotropia which had developed. The examination of the eye showed a complete hyaloid artery extending from the remnants of the posterior capsule backward to the papilla.

How the absorption of the cataracts was brought about in the first case can only be conjectured. It has been shown by Mann and others that the remnants of the hyaloid structures sink to the lower part of the vitreous and can always be brought into view of the biomicroscope by having the patient look strongly up or down and then bring the eyes into primary position. There is probably the same tendency for the retained artery to fall and this may make constant traction on the capsule which may cause it to rupture, possibly at the equator, permitting intracapsular access to the aqueous and consequent absorption of the lens matter.

The central hyaloid artery lies in a canal in the vitreous lined by a

hyaline membrane, the canal of Cloquet. Only the posterior part of the artery has a cellular sheath, anterior to this it lies in the canal. The latter broadens out funnel-like. When the central hyaloid artery persists throughout its whole length and continues to carry blood, there is, according to Collins, a formation of fibrous tissue in the vitreous which is frequently associated with a defect in development of the posterior capsule of the lens. At first the lens substance in front of this membrane is clear, but in the course of time it becomes opaque. Collins states that even when the lens matter clinically appears clear, microscopically it may show changes which in many cases would cause the lens to become opaque if the eye had not been removed. Such eyes are usually undersized.

As these facts were obtained from eyes removed on suspicion of the condition being glioma, probably with the aid of the biomicroscope and a wider knowledge of the developmental anomalies of the eye, more instances of monocular cataract, of this origin in the young, will be met.

Ophthalmiatria

Dr. Burton Chance exhibited a rare treatise on diseases of the eye published in Latin by Wm. Coward, M.D., in London, 1706, entitled, *Ophthalmiatria*.

Coward was a candidate of the College of Physicians of London for many years and enjoyed the friendship of distinguished medical scientists of his day, but he had written much on philosophical and metaphysical subjects which had met with severe condemnation, even to that of the burning of his books by the common hangman, by order of the House of Commons. He had translated much from the Greek and Latin, and had turned some English poems into Latin. A number of the chapters in *Ophthalmiatria* bear titles similar to those used today; but there seem to be much doubt concerning those which we, in these modern times, would ascribe to cataract and to glaucoma.

One might conclude that in the seventeenth and eighteenth centuries diseases of the eye were attended to by physicians who had received distinct instruction in the observation of disease and in applying reasonable and satisfactory forms of treatment except in the surgical. In the history of the founding of the great London eye hospitals in the following century, we learn that the surgical treatment of affections of the eye had been for many years in the hands

of irregular practitioners, which no doubt was the case at the time of Coward, as there are few or no directions in *Ophthalmiatria.*

Ring Pigmentation of the Cornea

The report of a case of ring pigmentation of the cornea was made by Dr. T. B. Holloway and Dr. Perce De Long.

DECEMBER 20.

Intraocular Foreign Bodies. Presentation of Case

Dr. A. G. Fewell showed F. G., aged eight years, who, on November 23, 1928, was standing near a bonfire on a vacant lot when an explosion occurred and something struck him in the right eye. He was brought to our clinic at the Episcopal Hospital the following afternoon. The only evidence of external injury was a subconjunctival hemorrhage extending from the limbus of the cornea to the internal canthus. Near the center of this, about 5 mm. from the cornea, was a small depression where evidently a foreign body had entered. The tension was normal. Vision: O.D., 6/30; O.S., 6/23 (there being a high compound hyperopia). The ophthalmoscope revealed a few streaks of hemorrhage in the vitreous and the two glistening foreign bodies of metallic appearance about half the size of a split pea. One foreign body was situated slightly down and in from the disk, about 3 mm. in front of the retina; the other below and farther to the nasal side and just behind the lens; between them were several foreign bodies, each about the size of a pinhead. Two x-rays were negative for opaque foreign bodies and the electromagnet had no effect. The eye was observed with the ophthalmoscope while the magnet was being applied and there was not the slightest movement of the foreign bodies. I believe these foreign bodies are either glass or stone. At no time has the eye shown any sign of inflammation.

Star-figure in the Macula

Dr. Warren S. Reese presented two cases of this condition.

Case I, a colored boy, aged seventeen years, was first seen on

October 24, 1928. The day previous, while playing football, he was struck in the right eye by the hand of one of the players. This caused temporary loss of vision. When first seen the vision of the affected eye was 18/100. The lids were swollen and discolored and the bulbar conjunctiva quite red, mainly from subconjunctival hemorrhage. The pupil was horizontally oval and eccentric inward and dilated very little to atropine. The disk was of good color, but its edges slightly blurred. There was a vertical area apparently of exudation just to the temporal side, and, beyond this, several hemorrhages. Four days later the patient complained of diplopia and the eye was slightly divergent. The pupil was semi-dilated and the swelling of the lids, etc., had almost entirely disappeared. The disk edges were more markedly blurred and there was an exudate on the lower outer disk margin, and below this a less-clearly-defined, wing-shaped area which extended out into the fundus for about 2 Dd. The macular region showed a number of fine parallel lines. On November 1, the eye was much better, but there was still diplopia and the macular region presented a typical star-shaped figure such as we see in albuminuric retinitis. The vision was still 18/000. Vision now is 18/50 and there has been marked resorption of the star-shaped figure, so that at present it is not so typical as when first noticed.

Case II was admitted to Wills Hospital several months ago with a definite uveitis. There were deposits on the posterior surface of the cornea, marked blurring of the disk margins and congestion of the fundus. The macular region presented a star-shaped figure.

In both these cases the general physical examination was negative, especial attention being paid to the urinary examination. Case II at one time showed a positive Meinicke, but at no time a positive Wassermann, even under the provocative test. A third case of star-shaped figure was recently shown at Wills Hospital from Dr. Chance's service. This patient had certain signs which suggested a possible previous uveitis. Case I showed no signs of uveitis at any time, and trauma seemed to be the only causative agent. It would seem possible, however, that the injury might have caused a uveal or retinochoroidal disturbance which was the direct cause of the macular figure. The uveal involvement in the other two cases suggests this.

Embolus of a Branch of the Central Artery of the Retina

Dr. J. Milton Griscom exhibited a case showing an embolus of the inferior branch of the central retinal artery. The patient, who was suffering from a mitral regurgitation, suddenly lost the upper half of his visual field. Ophthalmoscopic examination showed a rounded, highly refractile dilatation of the inferior branch of the central artery of the retina just as it divided into the inferior nasal and temporal branches. The inferior nasal branch showed segmentation of the blood-stream, and the temporal branch appeared about normal, although along its course there was a dense, whitish opacity of the retina. After two months the appearance of the artery at which the embolus lodged was unchanged, but the two branches had become thread-like in size, with visible perivascular lymph sheaths. Central vision was 6/9, but the upper field of vision was lost.

Implantation of Endogenous Cartilage into the Orbit after Remote Enucleation of the Eyeball. Exhibition of Case

Dr. C. E. G. Shannon reported the case of Mary T., aged eight years, admitted to the Jefferson Hospital on September 17, 1928. She had had a Frost-Lang operation on the right side four months earlier, the gold ball escaping three weeks following the operation. Examination revealed a very deep, contracted socket and marked furrowing of the upper lid. It was first proposed to reimplant a gold ball in the socket, as advocated by Dr. L. Webster Fox. This operation had been attempted by the writer on a previous occasion without success, and therefore the remote implantation of an endogenous cartilage seemed more likely to bring about the desired result. Bagley, of Baltimore, has summarized the advantages of the endogenous implantation as follows:

1. Elimination of a foreign body—a fundamental surgical principle.
2. A rigid material is preferable, giving better motion to the artificial eye.
3. A nonirritating substance.
4. To replace the enucleated eye by material as closely related to it as possible, which would naturally be a living graft.

5. If autogenous grafts are used, the necessity of blood matching, etc., is eliminated.

We are familiar with the various substances that have been employed by different ophthalmic surgeons from time to time for purposes of implantation following enucleation—fat, fascia, cartilage, glass and platinum balls—each one has its advocate. At the Jefferson Medical Hospital it has been our custom for many years to use the gold ball. Dr. Wm. M. Sweet reported at one time over 200 cases in which he had employed the gold ball for the purpose of implantation, without a single failure. A remarkable record. The particular phase the writer wishes to emphasize in this report, is the fact that in his case a remote implantation was under consideration. In his limited experience, and in the experience of others with whom he consulted, the gold ball almost invariably escaped, or at least did not prove satisfactory. Consequently, Bagley's recommendation of the endogenous graft was appealing.

The operation was carried out on September 19, 1928, with the assistance of Drs. George H. Cross and H. L. Righter. Dr. Righter removed the costal cartilage of the sixth rib, measuring about 5 to 6 cm. in length, carefully retaining the entire perichondrium surrounding the graft. Bagley recommends, in his paper, that the perichondrium of the anterior surface be removed with the graft, the perichondrium being left on the posterior surface for future regeneration. Dr. Righter did not believe any danger would be incurred by removing the entire perichondrium with the graft, as the fifth and seventh ribs seemed to form a sufficiently firm support for the chest wall.

A horizontal incision was then made in the conjunctiva of the socket and the conjunctiva thoroughly undermined above and below. A vertical incision followed in the deeper tissues. Fortunately, Tenon's capsule was found with little difficulty and the graft was then carefully inserted in the capsule in the vertical position. Dr. Cross suggested insertion in this manner, as he felt it would fill out the socket to much better advantage. Tenon's capsule and the conjunctiva were then sutured and a firm bandage applied. For a few days the patient complained of some distress in the chest and, naturally, the reaction in the socket was marked. However, the chest wound healed rapidly, and, under cold compresses, the swelling of the lids and tissues of the socket quieted completely in the course of ten days to two weeks.

Magitot's insertion of the head of the femur of a dog's hind leg, an operation which I had the good fortune to witness at his clinic in the summer of 1927 with Dr. Zentmayer, may prove just as satisfactory, even though it should be a remote implantation as in the case presented in this paper. I think the success of the operation depends in a measure upon the finding of Tenon's capsule, always a conjectural matter in a remote implantation. In discussing the case with Dr. Shoemaker, he was of the opinion that the graft would be absorbed into the tissues and the value in filling out the socket would be thereby lost. Would not the retention of the perichondrium, both as to the anterior and posterior surfaces, tend to eliminate this possibility, as was done in this case?

Notwithstanding the apparently successful result in this case, it is distinctly a radical operation, and I would question its advisability except under unusual circumstances.

Discussion. Dr. G. E. deSchweinitz referred to Magitot's method, evolved during the World War, of utilizing satisfactorily formalized cartilage taken from a calf or lamb rib as an implant after enucleation. The prepared cartilage is always ready, and can be shaped to any size that is required for the purpose of implantation. Dr. deSchweinitz stated that he had not himself employed this method, but the primary results he had witnessed were good.

He referred also to the opinion held by some surgeons that cartilage transferred as an implant from the patient's rib is more satisfactory than that taken from an animal's rib, because the autogenous graft, it is said, establishes fresh communications with the bloodvessels in its vicinity, and becomes adherent to the capsule envelope.

High Hyperphoria Associated with Violent Headache, Corrected by Tucking

Dr. G. Oram Ring reported this case in which the patient, a young woman, aged thirty-eight years, had a refraction error in the right eye of a low mixed astigmatism, and in the left a low hyperphoric astigmatism. The error was complicated with a left hyperphoria of 15 degrees. The slitlamp study was negative, the fundi normal, and, aside from the muscle imbalance, the visual response in each eye was entirely satisfactory.

The strain to which she was subjected in her endeavor to correlate her vertical, horizontal and accommodative mechanism resulted in constantly recurring headaches. A shopping trip, riding in a trolley,

train or auto, any effort at reading or other near work, resulted in a pain, frontoöccipital, so severe as to send her to bed from twelve to forty-eight hours. The severity and recurrence of the attacks threatened chronic invalidism. She attempted to relieve the stress by head-tilting.

All the recognized methods of study failed of their purpose. She was finally persuaded to permit tucking of the left inferior rectus, which was done under ether on April 20, 1928. The ingenious tucker of Dr. William J. Harrison was utilized. The result was most gratifying. The hyperphoria was reduced to less than one degree, and the headaches apparently perfectly cured. The examination of the patient as of the date of the report confirmed this judgment.

Dr. Ring exhibited, in addition to the tucker of Dr. Harrison, a recent one by Dr. Parker, which was modified from the Todd instrument. The tucker arms are bent at a right angle, one arm thickened, allowing a notch in the center to faciliate the placing of the needle. Dr. Ring likewise exhibited the instrument of Dr. Thomas J. Clemens and that of Dr. V. Bishop.

Dr. Ring expressed the judgment that the tucking procedure had been so simplified by the Harrison instrument that the method would likely find an increasing application to our muscle problems.

Discussion. Dr. C. E. G. Shannon congratulated Dr. Ring upon the gratifying results obtained in his case of hyperphoria.

He considered the Harrison tucker efficient, not only in advancing the internal and external recti, but equally satisfactory in operations upon the superior and inferior recti, as was conclusively shown in Dr. Ring's case. The administration of ether may be regarded generally as somewhat of a handicap in determining the amount of tucking to be done, but no difficulty was experienced in this case, as the elevated eye was brought down to the plane of the fellow-eye with surprising accuracy and ease. The tucking operation in hyperphorias of 10 degrees or more seems especially suitable by reason of its simplicity and effectiveness, and far preferable to a tenotomy.

Final Report Upon a Case of Supposed Sarcoma of the Orbit

Dr. Edward A. Shumway made a final report on the case presented for diagnosis at the November meeting of the Section, in which there was proptosis of the right eye with diplopia, in a young girl, and enlarged glands in the neck. The laboratory tests were negative for lues; the blood showed an eosinophilia, and the stools were therefore

examined for parasites, but none were found. Examination of a small gland dissected from the neck proved the presence of a round-celled sarcoma metastasis, evidently from the growth in the orbit. The proptosis had increased, optic neuritis had appeared and the eye became blind. The girl was being given heavy doses of radium, but there was evidently a general sarcomatosis, and the prognosis was bad; she had lost weight and the general health was apparently getting greatly affected. Dr. Shumway had hoped the condition would prove to be due to focal infection in the tonsils or sinuses, but the diagnosis of sarcoma was unfortunately determined by the biopsy. Dr. Shumway exhibited microscopic slides of the involved gland, which showed very rapid growth; the type of the sarcoma was endothelial, and the cells showed a great number of karyokinetic figures.

Chondrosarcoma of the Orbit, Removed by Modified Kronlein Operation

Dr. Frederick Krauss reported a case of chondrosarcoma of the orbit in which the tumor was removed by a modified Kronlein operation. The tumor was subperiosteal, of the size of a walnut, and had completely dislocated the eyeball from the orbit. The gradual growth of the tumor had brought about a compensatory enlargement of the lids. Despite this, later the cornea became uncovered, owing to the extreme exophthalmos. The operation consisted in removing as much of the outer orbital edge and external wall of the orbit as was required to remove the tumor. This was done with a rongeur after the periosteum had been carefully separated on both sides. The skin incision was made horizontally, the incision in the periosteum vertically. This operation is similar to that performed by Dr. Harold Gifford. As a result of the suturing of the temporal fascia to the periosteum, very little deformity is obtained.

Interstitial Keratitis following Trauma; the Relation of Trauma to Syphilis in General

Dr. Joseph V. Klauder (by invitation) related the case of a married woman, aged twenty-one years, who presented interstitial keratitis involving the right eye. Ten weeks previously her baby hit the

patient's right eye with a broom. The eye became inflamed, which gradually emerged into interstitial keratitis. The patient was admitted to Wills Hosiptal four weeks after the injury with a typical interstitial keratitis. The left eye remained uninvolved. She has the facies of congenital syphilis, Hutchinson's teeth and a 4+ Wassermann reaction of the blood.

In Spicer's study of interstitial keratitis, 3 per cent of the cases there was noted a direct association with injury, that is, the injury was seen to pass into interstitial keratitis while the patient was under observation. In Butler's series 20 per cent were preceded by injury. Trauma in precipitating interstitial keratitis is of considerable importance in view of the Workman's Compensation Acts.

Interstitial keratitis following trauma to the cornea is not regarded as a coincidence in view of the rôle of trauma in determining localization of syphilitic pathologic lesions, as seen in a visualization of clinical syphilology and in experimental rabbit syphilis. The surgeon is cognizant of syphilis as a factor in the nonhealing of wounds, the nonunion of fractures. The laryngologist is reluctant to perform a septum operation on a patient with syphilis. Trauma caused by the blood-stream has been mentioned as a possible factor in the causation of aneurysms.

Trauma of the skin and soft tissues of a patient in the late stage of syphilis may result in the appearance of any of the clinical forms of late syphilitic lesions. Indeed, it appears from clinical observation that syphilitic lesions may develop in areas of the skin that have been traumatized shortly before the patient is infected with syphilis. The appearance of syphilides at the site of tattoo marks may be cited. (For a more detailed discussion, see the author's paper, "Syphilis and Trauma," *The Journal of the American Medical Association*, April 8, 1922, vol. 78, pp. 1029–1037.)

Studies in rabbit syphilis furnish definite proof of the rôle of trauma in determining the localization of syphilitic lesions. Traumatizing the skin of rabbits, then inoculating the animal with syphilis *via* the testes, results in a chancre at the site of the traumatized skin.

Discussion. Dr. G. E. deSchweinitz referred to the rather elaborate attention which Igersheimer pays, in the second edition of his book, *Syphilis und Auge*, 1928, to the relation of injury to interstitial keratitis. From the experimental standpoint, neither Igersheimer nor Clausen was able to demonstrate that injury plays an important rôle with respect to the development of keratitis in luetic animals.

Although there is no doubt that injuries of the cornea in persons with congenital lues have been, and may be, followed by interstitial keratitis, there is also no doubt, according to Igersheimer, that it has not been proved, in many of these cases, that the association was more than a coincidence.

Mohr's investigations are quoted, namely, those which concerned themselves with a review of Uhthoff's private material, whereby it was demonstrated that only twice among 670 cases could trauma be accused as an etiological factor in the development of specific interstitial keratitis, and in Igersheimer's own material (300 cases) there is not a single one which with certainty could be attributed to the influence of trauma. However, the observations of Spicer, Butler and Cunningham on the etiological influence of trauma in interstitial keratitis are well known. It may be, as Hans Barkan has said, that injury activates dormant spirochetes in the cornea. As the essayist has said, the subject is an important one, especially with respect to the just administration of the Workingman's Compensation Act, and it is hoped Dr. Klauder will continue his observations and report his results at a future meeting.

Dr. Shannon stated that the Section on Ophthalmology is greatly indebted to Dr. Klauder for his interesting discussion on this somewhat controversial subject.

He referred to the fact that Dr. Hansell, on several occasions in his clinic at the Jefferson Medical College Hospital, exhibited cases of interstitial keratitis in which trauma to his mind was the immediate cause. He thoroughly believed that at times a heredito-syphilitic individual could develop interstitial keratitis as a result of injury to the eye. Dr. Klauder's report would seem to confirm this belief.

Dr. H. Maxwell Langdon stated that he was very glad that Dr. Klauder had brought this subject up for consideration, with special reference to the effect it has upon compensation cases.

He thought of three instances where workmen developed interstitial keratitis and gave a history that a foreign body had struck the eye at the start of the condition. Careful inquiry among the people who first saw these cases, and treated them, proved that no foreign body was present when they were first seen, nor was there a mark of a foreign body.

He believed that frequently the patient believed he had a foreign body on the eye because of the first symptoms at the onset of the interstitial keratitis—congestion, lacrimation and the accompanying discomfort.

It is quite possible that a foreign body might cause congestion and allow the spirochetes, which had been hitherto latent, to be active in the part, but he thought that the majority of the cases where a history of superficial oreign body is obtained are probably incorrect.

PROCEEDINGS

OF THE

SECTION ON OTOLOGY AND LARYNGOLOGY

JANUARY 18

Some Measures which Seem to be Helpful in Preparing a Patient for Operation

Dr. Samuel M. Wilson has increased the good effect of hemostatic serum when used to control hemorrhage after tonsillectomy and guarded against the annoying allergic reactions by combining this substance with adrenalin and obstetrical pituitrin. Two cubic centimeters of serum are drawn into a syringe, to which 2 minims of adrenalin and 5 minims of obstetrical pituitrin are added; 5 minims are injected subcutaneously and the patient directed to lie down. If no reaction occurs in thirty minutes the remaining quantity is injected intravenously. In fifteen minutes the operation may be performed. This method has proved to be of value in patients whose coagulation times are unduly prolonged. The same injection was recommended as a preoperative measure in thymic patients.

If $3\frac{1}{2}$ grains of gallic acid and 320 grains of tannic acid are dissolved by heat in enough water to make 1 fluidounce, a thin mucilage will be obtained. This solution applied to raw surfaces after nasal operations apparently assists in healing. Inch strips of gauze moistened with this substance may be packed into the tonsil fossæ, where they will remain safely for twelve or more hours.

Congenital Auricular Anomalies, with Report of Case

Dr. J. Clarence Keeler said that a search of the records of admissions to the Jefferson Hospital for a period of thirteen years showed that only 13 persons out of 16,696 had come to the hospital on account of auricular anomalies. This rather argues against the frequent opinion and statement that such conditions are quite common.

Such defects may affect any portion of the ear and are of importance from the standpoint of (1) hearing loss or (2) cosmetic disfigurement. The most common type of malformation involves the auricle. This deformity often is the cause of various psychic disturbances and repression complexes. Complete absence of one or both auricles, asymmetry of the two ears, absence of a part of the ear, polyotia, macrotia, microtia, otopostasis, drooping ears, false position and synechia are the most common anomalies. According to embryologic study, the greatest number of ear anomalies are due to the development of this organ *in utero,* the most important factors being faulty closure of the two upper branchial clefts, arrest of the unrolling process of the auricle and splitting of the original formation. The external ear is developed from the first ectodermal branchial groove and its adjoining arches. The external acoustic apparatus represents the groove itself, which for a time is in contact with the entoderm of the first pharyngeal pouch. Later, however, this contact is lost, and toward the end of the second month of fetal life the center of the groove deepens, so that it comes to assume a funnel shape, this canal corresponding to the anterior portion of the meatus when fully developed.

From the inner (that is, ectodermal) surface a cellular plate grows back until it reaches the tympanic cavity. During the course of the seventh month this plate splits and the space thus added serves to form the inner portion of the external meatus. Much earlier (in the latter part of the second or the early part of the third month) the auricle has already begun to assume its definite form. It originally arises from the six elevations which appear, three on the mandibular arch and three upon the hyoid arch. Below these elevations upon the hyoid a fold of hyoid integument forms, the auricular fold or hyoid helix. Later a similar fold appears back of the first branchial groove, and this unites with the auricular fold to form the free margin of the auricle. The point of fusion of these two folds, according to Schwalbe, marks the position of the satyr tubercle, while Darwin's tubercle appears at about the middle of the margin of the free auricular fold and corresponds to the apex of the auricle in lower orders of mammals.

The tragus is derived from one mandibular elevation, the helix developing from the other two; the antihelix and the antitragus originate from the hyoid elevations. The lobule represents the lower end of the auricular fold. The auricular tubercles may not

fuse completely, fistulæ being thus left between them. Keith observed such fistulæ most often between the tragus and the root of the helix.

Such a complicated developmental process could not fail to result in anomalous formation with a fair degree of frequency, and the fact that such a relatively small number of deformities of the ear are recorded in medical literature indicates that it is exceptional for the victims of such malformations to seek relief. My experience does not lead me to believe that the malformed ear is any more likely to become diseased than the normal one, and it would seem that, unless disease intervenes, the average individual bears his misfortune as best he may and seldom entertains the idea of abolishing or ameliorating it.

A roentgen-ray examination is always essential in order to determine the condition of the deeper structures of an ear in which the auditory meatus is concealed. In many cases, expecially in children, such an examination yields exact results. Functional tests and vestibular examinations are of value in determining the condition of the auditory apparatus and thus indicating the result that may be expected from operative interference.

The choice of operation depends upon the particular case and no definite rules can be followed for dealing with these defects. The application of plastic surgery principles developed during the World War enables us to attain far more satisfactory results than were formerly considered possible.

The 13 cases previously mentioned were then presented by Dr. Keeler. From his experience with this type of case he concludes that malformations of this type have their origin in early fetal life, the cause of which is a mystery and beyond our control. The possibility of correction has, in many cases, been demonstrated, and every possible consideration should be given to methods of reconstruction so that defects both cosmetic and functional may be lessened or abolished.

The Surgery of Auricular Anomalies

Dr. Robert H. Ivy stated that the surgical correction of deformities and defects of the external ear is very discouraging. In this field the results obtained are far behind those of nasal and facial surgery. This is easily understood when one considers that the

structure of the ear is a thin plate of cartilage covered by two layers of skin. In cases where there is congenital absence of the external ear associated with absence of the external canal, although the internal structures may be intact, construction of an auditory canal is not a feasible procedure. It is not wise to attempt the construction of an absent auricle in infancy. The congenitally projecting ear can easily be brought into a neutral position by any one of a number of operations. Frequently it is necessary to utilize skin from the regions adjacent to the ear for the reconstruction of the auricle. Such procedures are only moderately satisfactory. Many times it is better to use an artificial ear, reproduced in vulcanite or cast in silver, painted a suitable shade and fixed to the skin with actor's cement.

Discussion. Dr. B. Alexander Randall stated that he was very pessimistic concerning the results of plastic aural surgery, and showed a number of slides which demonstrated the various possible ear anomalies.

Latent Infection of Sinuses with Symptoms of Lower Respiratory Tract Disease

Dr. Louis H. Clerf has found that sinus disease is extremely common in suppuration of the lung. He divides cases of bronchiectasis into two groups:

(1) those associated with sinus disease; (2) those in which no sinus disease can be demonstrated. In the first group there is frequently a history of cough, dating back to infection of childhood, and chest examination shows bilateral changes varying from a suppurative bronchitis to extensive bronchiectasis. Although there is often no history or symptoms of nasal infection, careful study practically always shows evidence of sinus pathology. In the second group the lung lesion was commonly unilateral and usually limited to a single lobe. In this type of case, sinus infection was practically never observed.

Treatment of these cases is very unsatisfactory when the disease has been of long standing. In recent cases, results can be obtained. Dr. Clerf is convinced that examination of a patient complaining of chronic cough is never complete until a careful study of the nasal sinuses has been carried out; a negative opinion on sinus disease should not be given until every diagnostic means has been used.

Latent Infection of Sinuses with Symptoms of Lower Respiratory Tract Disease

Dr. Austin T. Smith (by invitation) said that Sir St. Clair Thomson, in 1914, first called attention to the frequency of sinus suppuration associated with chronic bronchitis. The French army officers, Rist, Sergeant and Saylor, in 1916, made the first comprehensive clinical contribution concerning this condition. It was demonstrated in 1921 that infection can be transmitted to the lung from the sinuses: (1) by inhalation, or (2) by lymphatic absorption by way of the submaxillary and deep cervical nodes into ducts and veins to the right heart and then to the lung.

Association with many of these cases at the bronchoscopic clinic has lead to the following conclusions:

1. The importance of the relationship between latent sinus infection and lower respiratory tract disease is not generally appreciated by laryngologists or internists.
2. The coexistence of sinus disease and infection of the lower respiratory tract is not merely coincidental.
3. Every case with symptoms of bronchopulmonary infection which is not acute should be considered potentially as having sinus disease.
4. A negative report as to the presence of sinus infection in cases of bronchopulmonary disease should be given only after utilizing every means of diagnosis at our command and only after repeated study and observation over a period of time.
5. The difficulties of eliminating sinus disease as a diagnostic possibility are not generally appreciated.

Discussion. Dr. Nathan P. Stauffer asked how sinus disease in children was treated; also how lipiodol is removed from the lung.

Dr. George Fetterolf said that he was greatly impressed by this paper. In his experience the point has not been reached where the diagnosis of sinus disease is an exact science, even when all possible means of diagnosis are used. Dr. Fetterolf uses the nasopharyngoscope routinely. A negative diagnosis should not be given on one examination only, as conditions may vary from day to day. Years ago, winter bronchitis was often mentioned. This condition usually disappeared after the patient spent some weeks in a warm climate. This probably was nothing more than sinus pathology associated with bronchitis, as we all know that many sinus cases do better in the South. Treatment of these cases is very unsatisfactory.

Dr. Smith was asked to give an exact interpretation of the term conservative sinus treatment.

Dr. Smith, in closing, stated that treatment in children consisted of shrinkage of the nasal mucosa, negative pressure and colloidal silver. It is extremely important that the general nutrition of the child be given careful attention, therefore a concentrated fat-soluble vitamine diet is prescribed.

Dr. Clerf, in closing, said that sinus treatments apparently do benefit some of these cases. The materials used in outlining the lungs are harmless. Bismuth subcarbonate disappears in forty-eight hours. Lipiodal remains longer and may be present for weeks. In children 6 to 10 cc. are used, while in adults 40 cc. may be used without danger.

FEBRUARY 15

The Neurologic Aspects of Nasal Infections

Dr. Simon L. Ruskin (by invitation) said that many manifestations of sinus disease usually attributed to absorbable toxins are not necessarily so, but can be traced to nerve irritation from an inflamed mucous membrane. The effects need not be on adjacent structures, but remote effects may be produced through pathways which at first glance appear to be impossible, yet which may be traced by a fairly direct route. The paper of Dr. Ruskin dealt with the latter condition. Neurogenic disturbances arising from sinus infections were classified as follows:

1. Acute pains in sinus inflammation.
2. Chronic neuralgia.
3. Vasomotor and secretory states.
4. Systemic effects induced chiefly through the vegetative nervous system.

The nerve tracts concerned are the trifacial, the facial and the vegetative system. The symptoms arising from the seventh and vegetative nerve systems were especially emphasized. In lower animals the olfactory nerve probably plays no more important part than the three above-mentioned nerve tracts. The animal reacts to environmental changes reflexly with its eyes and ears, its sympathetic and endocrine systems. Disease processes, too, can stimulate these structures.

In the nose there is located the only superficially placed sympathetic nerve center, the sphenopalatine ganglion. Acute purulent sinus conditions cause few neurological disturbances, but the chronic cases in which the *x*-ray reports slight thickening of the lining membrane are more apt to have such symptoms.

A case of ophthalmic migraine occurring in an adult male, aged forty-one years, was cited which was entirely relieved after eight cocainizations of the sphenopalatine ganglion. Several other cases of a similar nature were described.

Dr. Ruskin believes tic douloureux to be the result of simultaneous involvement of the fifth and seventh nerves and that the nasal ganglion which receives fibers from both acts as the trigger of the attack. He feels that excellent results can be gained from treatment of the nasal ganglion.

Blocking of the nasal ganglion will relieve many cases of asthenopia. Here the pains are due to overaction of the facial muscles, resulting from irritation of the facial nerve *via* the nasal ganglion. According to Hunt, the nervous intermedius of Wrisberg is the sensory portion of the facial. From the geniculate ganglion, the ganglion of the sensory facial, the greater superficial petrosal nerve travels to the nasal ganglion. This connection is of great importance. This nerve contains taste fibers to the roof of the mouth and the side of the tongue, tear fibers to the lacrimal gland, motor fibers to the levator palati muscle and sensory fibers as well. The pains described as part of the Sluder syndrome, referable to the back half of the head, follow very closely the facial distribution rather than the trigeminal. Some cases show a decided "front-half" headache, others have pains in the "back-half" of the head. This Dr. Ruskin believes to be due to two different mechanisms—one trigeminal, the other facial. In the "front-half" type the pains are typically sensory; in the "back-half," they are myalgic. These pains are readily relieved by blockage of the sphenopalatine ganglion.

The myalgic nodes and painful muscles at the back of the head are vasomotor in origin. Mueller has shown that the nerve of Wrisberg carries cranial autonomic fibers, some of which pass to the nasal ganglion. Dr. Ruskin believes that these fibers also pass along the facial branches to the muscles, and that irritation of the cranial autonomics in the nose causes vasomotor spasms in the facial distribution. This spasm interferes with muscle metabolism and gives rise to local symptoms. The same mechanism can be used to explain the almost uncanny results obtained in cases of severe shoulder pain, lumbago and sciatica. Probably some cases of ear noises and impaired hearing are due to vasomotor disturbances in the ear and myalgic conditions of the stapedius muscle.

Dr. Ruskin feels that nasal pathology plays an important part

in determining the direction of the equilibrium of the vegetative nervous system, *i. e.*, the balancing of anabolic and catabolic changes. Frequently the pain and nausea of dysmenorrhea can be relieved by nasal ganglion treatment. Spastic states of the gastrointestinal tract sometimes can be corrected by similar therapy. The pathway here is most likely through the vagus, which is depressed through the nasal ganglion. One case of persistent asthma secondary to infection of the maxillary sinuses yielded to nasal-ganglion treatments.

Dr. Ruskin considers the catabolic type to have chiefly visceral and spastic manifestations, while the anabolic group shows muscular, vasomotor and secretory phenomena. Both types represent the systemic effects of nasal-nerve irritation.

Vasomotor states of the local nasal structures, resulting in sneezing and rhinorrhea, can be controlled by nasal-ganglion cocainization.

Discussion. Dr. T. H. Weisenberg said that his impression of the above paper was that if the patient complains of pains in the arms, pains in the legs, dysmenorrhea, intestinal trouble, headache, asthma or most any other disorder, take a chance; treat the nasal ganglion and probably there will be relief from the complaint. All pain sensation, in order to be appreciated as such, must reach the cerebrum, and all parts of the body are supplied with pain fibers. If the pain fibers from various parts of the body passed through the nasal ganglion, then blockage of the same would stop the pain. But we know that pain fibers from the leg pass through the cord and do not touch the ganglion in question.

The work of Dr. Hunt, on the sensory fibers of the seventh nerve, has been questioned. It is surprising that the ninth nerve, which beyond doubt carries fibers of sensation, was not mentioned in the paper. The involuntary nervous system would be a better name for the vegetative system. It has afferent and efferent paths, just as the spinal nerves, and differs from them in that the motor portion has its own separate ganglion. Visceral sensation passes through the posterior roots to reach the cord, the same as sensation from other portions of the body. Dr. Weisenberg has carried out tests to determine how much hyperesthesia is normally present. Forty years ago Head outlined various zones of hyperesthesia that occurred in disease of the teeth, tonsils, sinuses, etc. In appendicitis the zone of increased sensation is supplied by nerves from the ninth, tenth and eleventh thoracic segments. By no anatomic trick can pain of this sort pass through the nasal ganglion. The work of Dr. Sluder is interesting, but it is questionable if the so-called Sluder syndrome is really an entity. At any rate, here in Philadelphia, the results obtained by Dr. Ruskin in this type of case have not been secured.

Dr. Charles H. Frazier, acting at the suggestion of Dr. William C. Spiller, has perfected an operation for the relief of the pain of tic douloureux. This operation avulses the sensory root of the fifth, leaving intact the

fibers of eye sensation and the motor portion. In a series of hundreds of cases no fatalities have occurred, so that the operation need not be feared.

True cases of sciatica are rare. Most so-called cases are due to muscular pains secondary to disorders of the pelvic joints. The terms anabolic and catabolic carry the same message to the neurologist as vagotonia. True mental derangement does not result from infected teeth, tonsils, etc. Toxic effects may occur, but not true mental derangement.

Dr. Ross H. Skillern said that headaches in sinus disease may be the result of (1) irritation of nerve endings; (2) pressure; (3) negative pressure; (4) toxic absorption. These always overlap and are never distinct. They usually come on after arising in the morning, last several hours, then disappear. This may be due to the evacuation of pus followed by adequate aëration and drainage.

Mental states may occur during the period of sinus congestion. This sometimes is a feeling of apprehension, which is followed by depression, even melancholia. The causes of these mental conditions are either congestion of the meninges or absorption of toxins. As soon as ventilation and drainage are established, these symptoms disappear.

Dr. R. H. Thompson said that the nasal or sphenopalatine ganglion is one of four peripheral vegetative ganglia lying in close topographical relation with the fifth cranial nerve. The others are the ciliary, the otic and the submaxillary. All four are joined by connector fibers with the superior cervical sympathetic ganglion, which in turn has to do with the thoracico-lumbar or true sympathetic outflow from the spinal cord. In addition, each ganglion receives preganglionic fibers from a cranial nerve, analogous to the white rami communicantes from the spinal cord to the vertebral sympathetic ganglia: The ciliary from the third nerve, the nasal from the seventh, the otic from the ninth and the submaxillary, again, from the seventh.

Neuro-anatomists seem agreed that the centers for vegetative reflexes lie within the central nervous system and not within peripherally located ganglia. An afferent pathway, a connector and an efferent pathway are necessary for the reflex activity just as they are for a reflex of the voluntary nervous system.

For reflexes with which these four ganglia are concerned, the afferent pathway would lie within the cranial visceral afferent system, *i. e.*, the seventh, ninth and tenth nerves. All such fibers enter the tractus solitarius and end in the nucleus of that tract in the medulla.

From the afferent or sensory center, connector fibers are given off to be distributed to the visceral motor nuclei, including the nucleus ambiguus and the dorsal motor nucleus of the vagus. In this way arcs are established for a large and important group of reflexes.

The effector or motor fibers concerned travel along the cranial nerves, already mentioned, to end in the four terminal vegetative ganglia. From these new axons are given off to be distributed to the various structures of the head.

That the nasal ganglion, or any other peripheral ganglion, should be of such importance in the symptomatology and treatment of obscure neuro-

logical conditions, an avenue of approach to the vegetative system throughout its vast and complicated mechanism, seems to me to be beyond an anatomical explanation.

Dr. Ruskin, in closing, agreed that no possible pain pathway through the sphenopalatine ganglion exists, but suggested that the cranial autonomics may be important in vasomotor control. Then, too, the stimulation of the autonomic system gives a response out of proportion to the stimulus applied. Where headaches are of vasomotor origin they can be controlled by applications of cocaine to the sphenopalatine ganglion.

MARCH 21

Symposium: Sigmoid Sinus Thrombosis

Diagnosis

Dr. S. MacCuen Smith said that there should be no difficulty in establishing a diagnosis in a simple, uncomplicated involvement of the lateral sinus, but this characteristic clinical picture broadly means septicemia and must be differentiated from sepsis originating in some part of the body before surgical intervention is undertaken. Certain types of meningitis, central pneumonia, endocarditis, typhoid fever, malaria and pyelitis in children are to be eliminated as a causative factor when complicating an active or inactive suppurative aural disease; but once diagnosis is reasonably assured, the surgeon should lose no time in verifying his suspicions by surgical measures.

A perisinus abscess is frequently found when wholly unexpected during a mastoid operation and should not be disturbed unless definite symptoms of septicemia occur, for in many instances the mild pyemic symptoms entirely disappear following the mastoid operation.

The importance of the small veins in the tympanum and mastoid cells that communicate directly with the sigmoid sinus, which is primarily invaded by pathogenic organisms on account of its anatomical position, is not always appreciated.

When death occurs it cannot be attributed to the primary sinus thrombosis, but to the entrance of infection into the blood stream. In almost all surgical otology we are working in a field of sepsis, so that it becomes a relatively simple process, in cases of delites-

cence, for the infection to enter the jugular bulb or be carried to the sinus through the small vessels of the mucosal lining or thin bone.

In an involvement of the facial vein there is edema of the face, whereas a cavernous sinus implication is manifested by exophthalmos and edema of the lids. Thrombosis of the jugular bulb frequently produces paralysis of the pneumogastric, causing dyspnea, hoarseness, etc.

The operator is responsible for a number of sinus thromboses, due possibly to injury by a spicula of bone being carelessly wiped off an exposed sinus. A case of this nature was described.

Sinus thrombosis is to be suspected when the posterior part of the mastoid is chiefly involved, as manifested by pain on pressure and some edema, perhaps, over the emissory vein. Phlebitis of the lateral sinus is very rare in infants and those of extreme age.

Diagnosis deals with symptomatology of two sorts, both local and systemic. Sudden cessation of discharge in chronic otorrhea is indicative of several complications, among which may be sinus thrombosis. Marked pain over the mastoid tip, and extending down to the posterior cervical triangle, indicates that the vein is involved.

Local suffering may be slight or excruciating, and may radiate over any part of the head or neck. Torticollis and cervical and retromandibular pain assure involvement of the jugular vein. During the early stages of thrombotic development the patient is practically symptomless. A high postoperative temperature after mastoidectomy in children should not cause anxiety unless it persists. Neuroretinitis is not a reliable sign and is noted only during the later stages.

The classical symptoms of sinus thrombosis are pain about the mastoid region; a chill, with sudden rise of temperature to 105° or higher; nausea and vomiting, the latter not projectile as in meningitis; increased pulse-rate followed by sweating, and a high polymorphonuclear percentage and leukocyte count. In uncomplicated cases a clear mentality is one of the most characteristic symptoms of sinus thrombosis, differentiating it from otitic brain abscess and meningitis. A pulsating movement may be transmitted to a sinus through the engorged arteries of a hyperemic dura, and is, therefore, of doubtful diagnostic value.

Suspicion of sinus thrombosis should be immediately awakened if an acute exacerbation with chills and rise in temperature occur

during chronic otorrhea, especially where violent remissions and copious sweating occur. A fair percentage of thrombi are innocuous, and the patient may exhibit a good general condition with normal mentality, but possess chills and a range of temperature between 102° and 106°. Should metastases occur, the picture immediately changes: The patient looks and feels ill; the temperature reaches exceptional heights without the abrupt drop in uncomplicated thrombosis, and he becomes increasingly indifferent to his environment.

Blood cultures should be made, but it is often unwise to await the result. A negative culture does not exclude sinus thrombosis.

Given a typical case, with other sources of bacteremia eliminated, surgical intervention is indicated. Recovery depends almost entirely on early operation. A free incision of the sinus wall is the only certain means of determining the presence of thrombosis in strongly suspected cases.

Use of Manometer

Dr. Francis C. Grant said that the Queckenstedt test and its modifications depend upon the result of mechanical interference with the venous return from the cranial cavity which produces a momentary increase in intracranial and intraspinal pressure. Queckenstedt, in 1916, demonstrated the fact that, following compression of both jugular veins, a marked rise in the fluid tension at the site of the lumbar puncture occurred. The Toby-Ayer test, a modification of the Queckenstedt test, determines which lateral sinus is obliterated by thrombosis. The lateral sinus empties directly into the jugular vein; a great part of the blood passing through this vein comes from this sinus. If for any reason blood through one lateral sinus is impeded, less passes through the jugular on that side. Hence, if less blood flows through the jugular vein on one side, its compression will cause but little damming back of blood within the cranial cavity and relatively slight rise in intracranial and intraspinal tension. The jugular vein on the normal side carries a relatively increased amount of blood. Compression of this vein should produce an increase in intracranial pressure comparable to that obtained when both jugulars are compressed. The test depends upon a comparison between the results obtained upon compression of the suspected and apparently normal veins. The technic differs in no way from the usual determination of the Queckenstedt test.

Toby advises that a water monometer be used. The Freemont-Smith manometer really used spinal fluid for the column of liquid and these types are more accurate than the mercury-containing types.

Proper compression of the jugulars was discussed. A number of kimographic tracings of such tests prepared by Dr. James Gardner, of the Frazier Clinic, were shown: 9 cases were discussed, 7 in which the test proved correct, 1 probably correct but unconfirmed, and 1 in which the findings were misinterpreted. Dr. Grant urged earlier and more frequent use of the test in the diagnosis of lateral sinus thrombosis.

Surgical Treatment

Dr. Curtis C. Eves said that free exposure of the sinus should be made before attempting to incise the sinus. A broad curette best accomplishes the final thinning of the bone over the sinus. A more rapid and accurate method, in experienced hands, for the removal of the initial portion of the sinus plate, is that of using a flat chisel about $\frac{1}{4}$ inch in width. The bone engaged is lifted by lowering the handle of the chisel and removing the chips with forceps. A small curved ronguer with blunt, rounded tips removes the remaining bone quickly and safely.

The sinus should not be opened before free exposure is obtained. The incision when made should be free to permit adequate inspection. Bleeding may be controlled with small, hard pledgets of iodoform gauze, the thickness of a leadpencil and about $\frac{3}{8}$ inch long. Larger pledgets, an inch square, should be available for emergency.

If a clot is removed for about 1 inch back of the knee, practically no troublesome infection extends beyond. No attempt should be made to remove the clot from the bulbar end without first ligating the internal jugular vein.

Treatment of the Jugular Vein. Three methods were described:

1. Cases without symptoms of general infection before operation, but with a thrombosed sinus at operation, are handled by dissecting away the diseased walls of the vein and packing lightly for drainage. The jugular is not ligated unless there are symptoms of bloodstream infection.

2. Cases developing acute septicemia or pyemia previous to operation receive simple ligation of the jugular as soon as sinus disease is demonstrated.

3. Cases of Class 2, in which the jugular vein being exposed and a clot in the vein or inflammatory adhesions surrounding the vein are found, the vein is dissected out to the lower limit in the neck.

The surgical requirements in the treatment of sinus infection are removal of the cause and limiting the extension of the infection.

Intravenous Therapy

Dr. Harold W. Jones (read by Dr. Mackmull) said that the treatment of blood-stream infection in sigmoid sinus disease is essentially the same as blood-stream infection in general. An attempt may be made to sterilize the blood, prevent or inhibit the growth of bacteria, remove bacteria by bleeding and replacing with normal blood, give the patient immune bodies or supply new blood to combat the anemia.

Dyes, such as aniline gentian violet or acriflavine, arsenicals, sodium cacodylate, mercurials, iodine (Pregel's solution), serum and blood transfusion were discussed. These substances not only affect the bacteria themselves but stimulate the body protective forces. In 6 cases treated with metaphen and transfusion, the blood cultures were negative after two or three injections. The chief indication for transfusion is the presence of secondary anemia. Exsanguination transfusion is practical only in very small children. Blood from immunized donors produced no unusual benefits.

Toxic symptoms with acriflavine and mercurochrome are encountered, while with metaphen in proper dosage the reactions are rare.

Removal of infection from the circulating blood does not always mean improvement. A case in point died of cavernous sinus thrombosis although the blood had been rendered sterile. Moreover, seemingly hopeless cases of blood-stream infection may get well spontaneously. Transfusion and intravenous therapy cannot replace skilful surgical treatment of sinus thrombosis, but transfusion may improve the general condition and shorten convalescence.

Intravenous medication alters blood agglutinins, so that clumping of the donor's cells may result. Patient and donor should, therefore, be crossed before each transfusion.

Intravenous medication was urged as a rational therapeutic measure.

Discussion. Dr. B. Alexander Randall: Where thrombosis is the most striking feature we may be certain that infection has preceded the

thrombus. The removal of the focus is indicated because of this infection. There is usually a sterile thrombotic mass at either end. The vein is the focus of most of the infection. Frequently, a needless amount of infected vein is left behind where the sinus wall should have been removed.

There is some essential difference between the acute and chronic suppurations of the ear. In the case of the acute ones the knee of the sigmoid and the bulb of the jugular are involved, particularly in children. I have seen just as many cerebellar abscesses as cerebral abscesses in these cases, but they are all a frequent cause of cerebellar abscess.

Clear-cut symptoms are often misleading and the diagnosis is not as simple as the accurate statements frequently indicate. A hectic temperature, however, means involvement of serous membrane.

The first operation for sigmoid sinus disease was done in Philadelphia by Dr. Ashhurst. The case was one of thrombotic obstruction in the lateral sinus and was operated on ten years before the method was at all discussed on either side of the Atlantic.

Dr. Nathan P. Stauffer: Not all cases are typical; 3 cases I have in mind had no chill, were clear mentally and had headache as the chief symptom, and yet all 3 cases had clots at operation. In 1 case, a child, the lateral sinus and the jugular vein were full of pus at operation.

Pressure must be exerted carefully to elicit symptoms. In 3 of my cases the manometer was of value; 1 of these was not confirmed, but I think it is a valuable diagnostic aid.

Three cases were cured by transfusion. The first of these was transfused twice because of continuance of headache. Another, a child, received two transfusions before operation and none after. I am a convert to blood transfusion in these cases.

Dr. Fielding O. Lewis: A case of lateral sinus thrombosis with streptococcic blood-stream infection was treated with metaphen and transfusion. Following the metaphen there were definite symptoms of nephritis, but they cleared up several days later.

The temperature dropped but was not flat, and in the past two days the patient has shown symptoms of encephalitis. Dr. MacCuen Smith used gentian violet and the case now seems improved.

Dr. George M. Coates: Diagnosis of this condition is difficult. The laboratory aids are important, especially the blood culture. The negative blood culture is of no help, but the positive blood culture is helpful. However, a culture immediately after operation may show bacteriemia when no real infection may be present. The interpretations depend on the time when the blood culture was taken. Between chills the blood culture may be negative, while during chills the blood culture may be positive. We should consider not only the leukocyte count, but the hemoglobin percentage and red cell count as well. The latter two go down progressively in streptococcic infections. The manometer has not been very successful in my cases, but this is due probably to an error in technic.

In my experience, transfusion has given better results than any other procedure. Concerning the use of immunized donors, I think a case in point will be of interest. A child of two years was operated on and was trans-

fused from the father. Improvement followed, but later the temperature went up again. The mother's blood was used for a second transfusion and the temperature remained normal. The mother, we found, had had a streptococcic infection several years before. I would like to ask Dr. Mackmull if he considers this a case of retained immunity?

In consultation with a pediatrician, I saw a case of apparent sinus thrombosis. Although almost a typical case, we waited. The patient got entirely well without treatments. I would like to ask Dr. Eves why he severs the jugular after tying. It seems to me that severing the jugular adds to the danger of spreading infection (descending phlebitis). It is often remarked that the wrong jugular may be ligated. Cases in which ligation of both jugulars were not followed by harm are reported, but the case reported had an interval of a week between the ligations, thus allowing collateral circulation to develop.

I would like to ask Dr. Grant what effect the administration of magnesium sulphate would have on the manometer reading?

Dr. Robert Hunter: I think the water manometer is safe in Dr. Grant's hands, but believe that in average hands the Quincke manometer is safer because of the rubber connections. The necessity of careful sterilization is another point in favor of the Quincke apparatus. In a patient with symptoms of meningitis we desired to eliminate the possibility of sinus thrombosis. A smear from the spinal fluid showed a few bacteria, but cultures from the spinal fluid showed no growth. We decided to operate because the other findings did not contraindicate operation. We were forced to speculate as to whether the manometer had been clean. I am wondering, therefore, if when the spinal fluid rises in the manometer on jugular pressure, the fluid later dropping back upon the release of pressure, does not reënter the spinal canal and offer chances of infection.

Dr. James A. Babbitt: I think Dr. Mackmull's quantities as to dosage in intravenous therapy are of sufficient importance to warrant repetition.

Dr. MacCuen Smith: It has been my custom to use the Alexander chisel, striking it with a hammer so that the end is brought up with each blow, and in this way no damage can be done. We must get off the wall without injuring the sinus. The safest procedure is to take this off parallel with the sinus. I believe it is well to prepare for the bleeding, as Dr. Eves has suggested. Where there is free bleeding it is not always necessary to ligate the jugular. Free bleeding from each end probably washes out all the infection, and I have seen a number of cases get well without ligation. As long as the endothelium is not involved, it is remarkable how much of the wall of the sinus may be involved without thrombus formation.

Dr. Grant: Average care in sterilization should eliminate danger of infection in the use of the manometer. Rarely, even in inexperienced hands, is infection produced in the many instances of routine lumbar puncture.

Dr. Curtis C. Eves: I always feel safer when alcohol is used upon severing the vein. I must confess that I have had no experience with the lip Dr. Hunter mentions. Dr. Smith suggests plugging under the bony walls before opening the sinus. Pushing the plug down may loosen the clot and thus get into the circulation. In 1 case the vein became occluded down into the neck.

Dr. Mackmull (by invitation): Certain antigens, such as those in scarlet fever, are known to persist many years. The case suggested by Dr. Coates may be of this order. As to the dosage of metaphen intravenously, we use 0.5 cc. of a 1 to 1000 aqueous solution per kilogram of weight in children, and in adults we use 10 cc. of a 1 to 1000 aqueous solution, irrespective of the weight of the individual.

APRIL 18

Two Cases of Otitic Meningitis

Dr. George B. Wood reported the case of a negro female, aged twenty-two years, who came to the dispensary of the hospital complaining of discomfort in her right ear. The canal of this ear was blocked by a large polyp, around which was exuding a moderately purulent discharge. The left ear also showed a purulent discharge, with destruction of the drum. The polyp was removed by torsion and she was allowed to go home. Two days later she began to have pain in the right ear and right side of her head. This became more severe, and two days later she was slightly delirious at times. She was admitted to the hospital about midnight the next day. Her general appearance was that of a normally developed, well-nourished, young colored woman, excited and delirious. Temperature, 103°; pulse, 100; respiration, 25. The patient was irrational and delirious, though responding to external stimuli and becoming more excited.

The left ear canal was filled with purulent material; the tympanic membrane almost completely destroyed. In the right ear the canal showed even more thick, creamy pus, with destruction of the tympanic membrane. There was no definite swelling or tenderness over either mastoid. The pupils were equal, regular in outline and responded slowly to light. The nasal fossæ were free, without discharge. The tongue was heavily coated and the mucous membrane of the pharynx was rather pale. The tonsils were negative. There was no motor paralysis of the face and no accessory disturbance. There was distinct rigidity of the neck, and on flexion a suggestive Brudzinsky sign had developed. The chest was normal except for slight impairment of percussion note over the right scapula. Breath sounds normal and no râles. The pulse was rapid but regular, and the heart sounds normal except some accentuation of the aortic

second. Blood-pressure, 135/80. Abdomen negative. Reflexes of the arm were rather active, but equal. No motor disturbances. The legs were held partly flexed at knees and hips, and she occasionally exhibited minor convulsive tremors of slight duration. The knee-jerks were equal, but very active. Kernig's sign positive both sides. Babinski doubtful. There was no ankle clonus.

On lumbar puncture the spinal fluid was very turbid and under increased pressure. There were leukocytes too abundant to be counted, but at least 90 per cent of them were polymorphonuclear. The same day a radical mastoidectomy under general anesthesia was performed. There was complete eburnation of the whole mastoid process, with minute scattered areas of necrosis and pus. Above there was a larger area of necrosis and the dura in the middle cerebral fossa was exposed. The antrum itself was very small and was only reached after the posterior superior walls of the canal had been removed. Both it and the tympanic cavity were filled with purulent débris and granulation tissue. On raising the dura around the margins of the exposure in the middle cerebral fossa, no extradural collection of pus was found, though there was some granulation tissue on the dura where it was exposed. The dura was also exposed over the lateral sinus, but in this region appeared normal.

No improvement followed this operation and the patient steadily became worse. Signs of meningitis were definite and the spinal fluid contained many pus cells and pneumococci. About an hour before death all the muscles of the body relaxed.

Careful microscopic examination of the polyp showed no evidence of dural prolapse. Postmortem examination of the interior of the skull showed some inflammatory exudate around the region of the auditory nerve and an extradural collection of pus on the anterior surface of the petrous portion of the temporal bone, with a perforation through the tegmen.

A second case was that of a girl, aged ten years, who developed an acute otitis twelve days after being struck on the right ear with a snowball. This was treated at home until she developed chills and fever and some stiffness of the neck, upon which she was admitted to the Howard Hospital.

A spinal puncture at this time gave negative findings. She had complained of some pain in the left ear, but this ear had not discharged.

The left ear canal was free. The tympanic membrane was slightly retracted with some congestion of the manubrial plexus. There was no tenderness or swelling over the mastoid. On the right, the canal contained mucopurulent secretion. The drum was congested, with a posterior perforation which had been previously enlarged. There was no edema of the canal wall. There was very slight swelling and some tenderness over the mastoid antrum and tip. There was no swelling of the neck, though the tonsillar lymph node was somewhat enlarged on the left side. Except for some congestion of the pharynx, the nose and throat were negative. *X*-ray examination of the mastoids showed cellular destruction on both sides, more marked on the right.

The diagnosis was probable lateral sinus thrombosis, but some doubt as to which ear was responsible; also probable pneumonia.

Eye-ground examination showed swollen nerve-heads on both sides, with distinct signs of optic neuritis of three diopters.

The temperature of this child on admission was $104\frac{2}{5}°$, which rose during the night to $106\frac{4}{5}°$. The pulse-rate varied between 130 and 160; respirations between 40 and 70. The discharge from the right ear was very profuse.

A simple mastoid operation was performed. The periosteum was slightly adherent, the cortex practically normal; but after its removal the rest of the mastoid process was found to be practically destroyed and a large perisinus abscess present. Bleeding was free and difficult to control both from the skin and from the bone. The dura was markedly thickened, congested and the surface covered with more or less adherent exudate. After iodinizing the surface of the dura, a large hypodermic needle was pushed into what was supposed to be the sinus, but no blood was obtained. The dura was then incised at this point and a collapsed sinus without blood or other contents was found. A curette introduced posteriorly for $1\frac{1}{2}$ inches failed to produce bleeding, but some shreds or necrotic material were obtained. The internal jugular was then ligated by Dr. A. C. Wood. After ligation of the internal jugular the bulb was curetted and a small amount of bleeding was obtained. Immediately after the operation the child was given 20 cc. of pneumococcus antibodies intravenously and 25 cc. under the pectoral muscle. Although the child's condition during the operation was not very good, she reacted well and her temperature came down to $99\frac{4}{5}°$, pulse from 180 to 116. Later that night, however, the temperature rose to 104°, pulse, 130; respirations, 50; and the child became restless and irritable, perspiring freely and at times irrational.

Twelve hours later the child was given 45 cc. pneumococci antibody serum intravenously and a blood transfusion an hour or two later. About 350 cc. of citrated father's blood was used. The child's temperature fell after this to $97\frac{3}{5}°$; pulse, 90; respirations, 40; but was in a generally weak condition. The temperature, however, rose to 104° the next morning.

Two days after operation a lumbar puncture showed moderately turbid fluid under definitely increased pressure, with about 357 cells, but no organisms on direct smears, the culture of which, however, showed pneumococci present.

From this time the patient ran the usual course of meningitis with the usual termination. Postmortem examination of the wound gave evidence of a pus collection and thrombosis in the region of the torcula.

The Radiological Signs which Indicate Extension of Infection from the Ethmoid and Sphenoid Sinuses to the Base of the Skull (Illustrated by a Series of Lantern Slides)

Dr. G. E. Pfahler said that inflammatory processes about any of the accessory sinuses are apt to extend into the bony wall and give rise to an osteitis. This osteitis is indicated at first by absorption of the lime salts, due to the action of the osteoclasts. Later there is a reaction, and, due to the action of the osteoblasts, there is an increased deposit of lime salts, making the affected bone more dense than normal and also interfering with the cancellous structure. This reaction in the bone has been recognized in the frontal bones and in the mastoid areas, in connection with inflammation of these cavities. It is now being recognized in the walls of the ethmoid cells, the sphenoid sinuses and extending into the base of the skull. This involvement of the base of the skull may extend to the anterior, middle or posterior fossa, but most commonly involving the middle fossa of the skull. It is shown on the side in which there is sinus involvement. The intimate connection of this bone with the dura will indicate the importance of giving such involvement considerable thought.

Discussion. Dr. Henry K. Pancoast stated that the principle of osteoporosis and sclerosis is not new and is always considered in the interpretation of mastoid films. Too little attention is paid to thickened sinus walls. Much thickening of the wall indicates a long-standing infection. He doubts if the posterior clinoid process can be influenced by a sinus disease.

Dr. William Whalen (by invitation) mentioned one case, referred to by Dr. Pfahler, who developed a fatal meningitis following a right sphenoethmoid operation.

Dr. George B. Wood did not understand how osteitis extending over the base of the skull could be due to sinus disease. He asked if this conclusion had been proven by histologic studies.

Dr. Pfahler stated that he has not had the opportunity to prove his statements by microscopic study.

Dr. B. A. Randall asked if the cavernous sinuses had been examined in these cases. He said that if a thrombosis of the cavernous sinus had been present, exophthalmos would most probably have been present. When an extradural abscess is present, meningitis and even brain abscess may occur with no demonstrable dural opening. Attention was called to the slowing of the pulse in brain abscess. Many observers fail to record this finding in cases of brain abscess.

Cerebrospinal Rhinorrhea following Intranasal Surgery. Collection of Cases and Report of One Such Case

Dr. Edward H. Campbell said that the escape of cerebrospinal fluid following operations within the nose is apparently a very rare occurrence, as but few cases have been reported in the literature. The spontaneous escape of the fluid and cerebrospinal rhinorrhea following injuries to the head, however, have been the subject of many articles during the past thirty years.

Sir St. Clair Thomson, in 1899, reported a case of his own, along with 20 others collected from the literature. He selected these cases as representing spontaneous escape of cerebrospinal fluid from the nose, and excluded those cases which followed injuries or were probably due to intracranial tumors.

These 21 cases included 9 in which the discharge was undoubtedly cerebrospinal fluid, and 12 in which the discharge was most probably cerebrospinal fluid. In addition, he collected 8 other cases that were suggestive of an intracranial origin of the nasal discharge. Seventeen of his 21 cases showed cerebral symptoms, and Dr. Thomson considered that they might possibly have been due to internal hydrocephalus having as its basis a serous meningitis. Postmortem examination in 4 of the cases gave no evidence to disprove his hypothesis.

In a recent search of the literature, Locke found 14 fatal cases of spontaneous cerebrospinal rhinorrhea in which necropsy was performed; 2 of these reports were incomplete and the remaining 12 showed internal hydrocephalus. In 8 of these the hydrocephalus was due to a cerebral tumor which caused an obstruction within

the ventricle system; 2 were of congenital hydrocephalus in which rhinorrhea developed in early adult life after the fontanels and sutures had closed, and 2 were cases of hydrocephalus of the adult type.

Eleven of these 12 reports showed that there were openings between the floor of the anterior cranial fossa and the nasal cavity. In the twelfth case only a thinning and no opening was found.

In 1926, Johnston made a detailed report of 21 cases of all types of cerebrospinal rhinorrhea. These included 1 of his own and 20 collected from the literature published since 1900. Since the publication of Johnston's article there have appeared 9 more cases. Among these there have been but few that have been attributed either directly or indirectly to intracranial operations.

Dr. Campbell reported the case of an adult female upon whom he performed a right ethmoid operation on account of infection in these sinuses associated with bronchial asthma. While in the operating room, after opening of the anterior ethmoid cells, a rather profuse, thin, bloody discharge in the throat was noticed. This later lost the bloody tinge and was obviously spinal fluid. No symptoms except generalized headache lasting several hours was present. Large amounts of fluid were given by mouth with the idea of preventing any negative intracranial pressure and the subsequent sucking-in of infected material. The head was maintained level with the body. The discharge stopped entirely in twenty-five hours and complete recovery followed. She has been followed for about a year following operation and reports no symptoms to date.

Exhibition of a Device for Making Simultaneous Bilateral Stereoscopic Roentgenograms of the Mastoid Cells

Dr. Henry K. Pancoast

Clinical Observations of X-ray Diagnosis of Maxillary Sinus Disease after the Injection of Lipiodol, and Deductions from the Pathological Reports from One Hundred and Fifty Radical Maxillary Sinus Operations

Dr. Matthew S. Ersner (by invitation), stated that the maxillary sinus is one of the great sources of focal infection that is frequently overlooked. It may become infected from below by the teeth or from above by the adjacent sinuses. Pus may drain into the antrum

from above, the antrum acting as a reservoir for infected secretions. In addition, it may be diseased on account of infection arising within the antrum itself.

In the cases examined by Dr. John Kolmer the following classes of diseased mucosa were found:

1. Hypertrophic changes—fibromyxoma (polyp).
2. Hypertrophic changes of cystic fibromyxoma.
3. Early atrophic changes.
4. Hypertrophic and atrophic changes.

When the antral mucous membrane has passed the stage of resolution and has reached the point of myxomatous change the ordinary intranasal operations are of no avail. The final decision for radical operation was based upon:

1. The failure of the mucous membrane to undergo resolution after the establishment of ventilation.
2. The thickness of the mucous membrane, visualized by lipiodol and confirmed by *x*-ray, showing oil retention and delayed antral excretion.

The roentgen-ray examination after lipiodol injection is of particular value in cases of atrophic conditions of the maxillary sinuses. Ordinary sinus examinations in these cases are usually negative; with lipiodol one learns:

1. The size and outline of the sinus cavity.
2. The condition of the mucous membranes.
3. The ability of the ciliated epithelium to eliminate the lipiodol. (The normal sinus eliminates the lipiodol in twenty-four to forty-eight hours.)

Some cases may show a colorless mucinlike fluid in the maxillary sinus which is easily overlooked when puncture and irrigation are performed. Many of these cases simulate allergic nasal conditions.

Dr. Ersner feels that intranasal surgery will not check the progress of polyp formation nor eliminate focal infection. In a group of 150 cases, 30 patients had intranasal surgery whose focal symptoms did not improve. In 8 cases radical operations were performed, but the diseased mucous membrane was not entirely removed. These cases, too, still showed evidence of infection. It is believed by Dr. Ersner that in the radical operation all the diseased mucous membrane should be removed.

The technic of Dr. Ersner in establishing infection of the antrum is as follows:

1. Nasal infection outside the antrum is eliminated by shrinkage, suction, packing and posture;

2. Transillumination: A clear antrum indicates over-developed, normal, atrophic or cystic conditions; darkness indicates pathology.

3. Puncture and irrigation show the presence or absence of pus.

4. Roentgen-ray studies: It is of great value to have these studies made, both before and after irrigation.

5. The introduction of lipiodol, followed by roentgen-ray studies. This gives information regarding the size of the antrum, its topography, the nature of its mucosa and adequacy of the cilia.

6. Cytology of maxillary sinus pus. In acute conditions polymorphonuclear cells predominated; in chronic, mononuclears.

The symptoms of this condition are very varied. The respiratory system is most often affected by persistent cough, bronchial asthma and hoarseness. Bronchiectasis may be the sequel. Asthma is often associated with nasal polyps. The cases studied by Dr. Ersner showed chronic infection of the maxillary sinuses in 80 per cent of nasal polyp cases.

The statistics of the 150 cases reported are as follows:

1. Ages: One case, aged eight years, had a fistula of canine fossa. Otherwise the ages ranged between sixteen and seventy-one.

2. From the study of 150 cases, he found that 80 per cent were associated with polyps; 25 per cent had chronic maxillary antra acting as a source of focal infection, but their symptoms were not referable to the antrum or the nose.

3. Other previous nasal operations: 48 submucous resections; 54 turbinectomies; 24 removal of polyps; 6 ethmoidectomies; 1 sphenoidectomy.

4. Other previous intranasal maxillary operations: 8 canine fossa; 30 intranasal maxillaries.

5. Radical maxillary operations: 18 bilateral Caldwell-Lucs; 126 single Caldwell-Lucs; 6 Denkers.

6. Anesthetics: General, 38. Local: 10 supraperiosteal; 102 block anesthesia.

7. Bacteria found (on a basis of 50 cases): 3 mixed types; 3 pneumococcus; 1 nonhemolyticus streptococcus; 4 staphylococcus albus; 11 staphylococcus aureus; 15 streptococcus nonhemolyticus; 16 streptococcus hemolyticus.

Discussion. Dr. John Kolmer said that the pathology of this condition corresponds in a broad way to the pathology of acute and chronic infection

elsewhere. Many cases showed myxomatous changes of the fibrous tissue of the submucosa. Atrophic and hypertrophic changes were often seen together. Retention cysts were sometimes present in the submucosa. Few bacteria were present, the most common ones being of the staphylococcus, pneumococcus and streptococcus groups.

Dr. Karl M. Houser showed a series of lantern slides demonstrating the value of lipiodol in the study of sinus conditions and commented upon the operative findings in some of these cases.

Dr. William Ersner (by invitation) stated that 18 per cent of the cases reported were of dental origin. In operation, block anesthesia is the method of choice. In the differentiation of dental cysts, lipiodol is of particular value.

Dr. B. Alexander Randall stated that the *x*-ray reports are not always satisfactory and sometimes are misleading. One of his cases demonstrated by the *x*-ray revealed breaking down of the mastoid process. Operation did not verify this finding. Only the most expert interpretation of *x*-ray findings is of value. Transillumination is of great value and should not be discarded for the *x*-ray.

OCTOBER 17

A Case of Dyspnea in a Child, One Year old, and Otitis Media Complicating a Case of Pneumonia

Dr. Thomas G. Aiken presented the case of a child, aged one year, with troublesome dyspnea. The thymus was decidedly enlarged, and this was supposed to be the cause of symptoms. However, the difficulty in breathing did not disappear after reduction of the thymus by radiation. After the introduction of a bronchoscope, it was found that the dyspnea was caused by a transverse band of mucous membrane partly obstructing the trachea about 1½ inches above its bifurcation.

A second case was that of a child who developed an acute otitis during an attack of pneumonia. After recovery, it was discovered that the child had a chronic ethmoidal condition which antedated the onset of pneumonia. Dr. Aiken raised the question whether this focus of infection had not really been the cause of the pneumonia.

Discussion. Dr. B. Alexander Randall said that he felt that the possible relation of pneumonia as an agent causing otitis should have more attention, and queried whether an ear which is the seat of a chronic infection might sometimes give rise to pneumonia. One must always be on guard for cases of thymic dyspnea.

Dr. George B. Wood stated that he is partial to the use of carbolized glycerin in the treatment of otitis media. The glycerin does not dry, and on account of this the canal is not blocked by dried secretions.

Complete Facial Paralysis and Meningitis as a Complication of Acute Otitis Media

Dr. David N. Husik reported the case of an adult female who developed left facial paralysis two days after the onset of acute otitis media of the left ear. Upon admission to the hospital evidence of mastoid suppuration was discovered and mastoidectomy was performed. The facial paralysis recovered promptly, and she was soon discharged from the hospital. She was readmitted eleven days after leaving the hospital with pain, temperature elevation and stiffness of the neck. The left mastoid wall was in good condition, but the right mastoid showed involvement. This was opened and pus released. The sigmoid sinus was exposed, but no evidence of infection was present. The spinal fluid was cloudy and contained hemolytic streptococci. Death occurred in a few days as the result of meningitis. Autopsy showed pus in both the sphenoid and ethmoid cells. The question raised was: Did the meningitis arise from the mastoid areas or from retained pus in the sphenoid and ethmoid sinuses?

Discussion. Dr. William Hewson asked if cultures had been made from the contents of the sphenoid and ethmoid sinuses?

Dr. George B. Wood said that it is his understanding that meningitis may occur in otitis with no evidence of continuity between the ear and the meninges. A similar case of basal meningitis was described, which showed no pathway of infection between the meninges and the ear.

Dr. George Fetterolf stated that Dr. Mosher, of Boston, feels that a close pathological tract between the ear and meninges is rarely found. To prove a pathway, careful microscopic examination is necessary and will perhaps reveal a septic thrombophlebitis.

Dr. Harry Rothrock (by invitation) called attention to a case of meningitis, seen some years ago, which was supposed to be of otitic origin. At autopsy nothing but a small flake of dried pus was found in the middle ear.

Angina, Blood-stream Infection and Agranulocytosis

Dr. Karl M. Houser and Dr. Edward Rose (by invitation) said that the literature of agranulocytic angina was covered in detail. At the present time, including the case reported by the speakers,

the total number of cases of this type reported is 78. The case reported was that of a female, aged forty-eight years, who developed sore throat, chills and fever. She gave the history of repeated attacks of quinsy, and when seen there was so much swelling of the left peritonsillar tissues that a pus collection was suspected. Incision of this area, however, revealed no pus. The next day she was admitted to the hospital of the University of Pennsylvania, when it was found that her total leukocyte count was 600 cells per cubic millimeter, with total absence of granulocytes. Platelets, red cells and hemoglobin were approximately normal. A blood culture showed a positive Type III pneumococcus infection. The patient died in three days in spite of repeated transfusions.

The literature of agranulocystosis reveals that many different organisms have been recovered from the blood stream, among which are hemolytic streptococci, staphylococci, B. pyocyaneus, B. coli, pneumococci and Streptococcus viridans. The speakers concluded that the condition termed agranulocytic angina could not justifiably be considered a specific disease entity, for the following reasons:

1. Marked leucopenia is well known to occur in severe infections of different types.
2. The variety of necrotic foci found in these cases argues against specificity in this same condition.
3. Epidemicity of the disease has not been reported.
4. The disease is not confined to middle-aged women. It has occurred frequently in males and age groups show a wide variation.
5. No constant etiologic agent has been established.
6. Satisfactory experimental reproduction of the condition has not been accomplished.

One pathologic finding of interest, which has never before been reported, was the necrosis of the walls of the arterioles and venules, with hyalinization of their contents.

Discussion. Dr. George B. Wood has seen 2 cases which he considered agranulocytosis. Neither one quite fitted the picture. The first was that of a boy, aged ten years, who in the terminal stages of his illness had necrotic lesions of the throat and a white-cell count of 1000, 1 per cent of which were neutrophiles. The other was that of an elderly woman who had bilateral myringotomy performed on account of slight inflammatory changes in the ear. She did not improve and a leukocyte count of 1000 was discovered, which in twenty-four hours dropped to 150 per c.mm. with no neutrophiles present. Death occurred in both cases.

Dr. Robert Hunter spoke of a case of sepsis with granulocytopenia which occurred in a woman following a simple fracture of one of the bones of the leg.

A Comparison of the Outlines of the Frontal Sinus, in Vivo, as Shown by Transillumination and Roentgen Ray

Dr. George Fetterolf and Dr. Edward E. Sprenkel (by invitation) said that the frontal sinuses of a group of medical students were studied in the following manner: Transillumination was performed and the upper margins of the frontal sinuses, as shown by transmitted light, were outlined on the patients' forehead with opaque paint. *X*-rays were then taken. The results were quite interesting in that each case showed that the frontal sinuses were much smaller than they appeared to be on transillumination. On the average, the frontal sinuses appeared to extend $\frac{1}{2}$ to $\frac{3}{4}$ inches higher in the frontal bone than was demonstrated by the *x*-ray.

Discussion. Dr. George B. Wood stated that he finds difficulty in procuring much valuable data from transillumination.

Dr. Curtis C. Eves was much interested in the findings reported, and feels that transillumination frequently gives information that is of great value and that cannot be obtained by the *x*-ray.

Dr. Philip Stout (by invitation) has found the findings of transillumination and the *x*-ray to agree remarkably well.

Report from British Medical Association of 1928

by Dr. George M. Coates

In the absence of Dr. Coates, Dr. William Hewson read his paper telling of the experiences of the writer while attending the above meeting.

November 21

Symposium on Anesthesia, arranged by Dr. Edward W. Beach (speaker by invitation).

Intratracheal Ether

Dr. P. J. Flagg, New York City, said that in order to secure the best results in surgical procedures, coöperation must exist between the anesthetist and surgeon. In operations on the head and neck and upper air passages it is difficult for the anesthetist, using the

ordinary methods of anesthesia, to avoid hindering the work of the surgeon. On account of this fact, Dr. Flagg advocates the use of intratracheal ether in operations of the upper air passages, head and neck. Certain instruments have been devised by him which have as their primary aim simplicity of construction and ease of manipulation. A detailed description of these instruments may be found in the *Archives of Otolaryngology*, May, 1927, and May, 1928. Another article in the *Journal of the American Medical Association*, September 15, describes this method. The apparatus used consists of a laryngeal portion about 4 inches in length, which is identical in construction with the Jackson bronchoscope. To this is attached a flexible portion long enough to permit its coming well out of the mouth. This apparatus is introduced under direct vision by means of a pocket-size electric laryngoscope devised by Dr. Flagg, a rigid obturator having previously been placed inside the flexible portion of the apparatus. After insertion, the obturator is withdrawn and the tubing is connected with an ether can in the top of which several holes have been placed. The can contains about an ounce of ether, and, by shaking, sufficient vapor is given off through the tube to maintain surgical anesthesia.

No irritation of the larynx has been observed by using this method. In addition, the presence of the bronchoscope in the larynx prevents the inhalation of blood during the operation. An apparatus designed by Dr. Flagg for the resuscitation of patients suffering from asphyxiation was demonstrated.

Discussion. Dr. Fielding O. Lewis said that by this apparently simple method described by Dr. Flagg the objections to intratracheal anesthesia were largely overcome. In using other methods, so much complicated apparatus was essential that in most clinics its use had been abandoned.

Dr. George Fetterolf asked how far the tube should be inserted into the trachea, and if this apparatus had been used in any thymic cases?

Dr. Flagg, in closing, stated that the tube is inserted its full length, which brings the tip about 1 in. from the bifurcation of the trachea. So far he has not had the opportunity of using this device in thymic cases.

Nitrous Oxide Anesthesia and Tonsillectomy

Dr. John H. Evans, Buffalo, N. Y., said that his paper was based upon his experience in 6000 tonsil cases which were operated upon using nitrous oxide and oxygen alone, and 10,000 tonsil cases using nitrous oxide, oxygen and ether. As in all surgical maneuvers, the safety of the patient demands first consideration,

which necessitates careful preoperative study and examination. The surgeon who demands a continuously relaxed throat for tonsil operation should not use nitrous oxide, but if he is willing to tolerate slight interruptions to regain the desired stage of anesthesia, nitrous oxide can easily be used. Of primary importance, however, is a well-trained anesthetist, preferably one having a medical training, as careful attention to small details is essential. Dr. Evans uses an apparatus carrying a large volume of gas, which can be operated by either foot or hand throttles. This gas is administered through a specially constructed nasal attachment and several oral tubes as well.

The advantages of this method are: (1) it is pleasant for the patient; (2) it can be used without danger where there is chest pathology; (3) it is not explosive; (4) the cough reflex is not abolished; (5) it does not subject the surgeon to prolonged ether inhalation.

The main disadvantages of this method are two in number: (1) the surgeon is sometimes inconvenienced for a short period of time in order to reduce the patient to the proper stage of anesthesia; (2) the surgeon may be spattered with blood on account of the vigorous "blowing" of the patient.

In addition to the disadvantages named, nitrous oxide anesthesia differs in certain ways from chloroform or ether. Sometimes it is difficult to estimate the depth of anesthesia. Color is not always a reliable guide and muscle signs must be carefully watched. There is usually an initial rise of blood-pressure, followed by a fall. In young children twitching of the facial muscles is frequently observed. The cost of administering nitrous oxide in tonsil operations averages about $10.00 per case. This prevents its use as routine in ward cases.

Discussion. Dr. C. M. Brown, of Buffalo (by invitation), said that on account of the expense of this type of anesthesia, Dr. Brown limits its use to those who can easily afford the additional cost of anesthesia, and cases in which other types of anesthetic are contraindicated. It is important to gain the confidence of the patient. The whole procedure is time-saving, the prompt induction of anesthesia and regaining of consciousness after operation are advantageous, and the operation can be just as thoroughly performed as when ether is used.

Colonic Anesthesia

Dr. Edward W. Beach said that this type of anesthesia is essentially suitable for prolonged operations on the head, neck and upper air passages.

The contraindications to its use are: (1) poor surgical risks; (2) when deep relaxation is necessary; (3) rectal pathology; (4) emergency operations; (5) where the anesthetic must be under absolute control.

The advantages are: (1) the anesthetist is away from the field of operation; (2) apprehension is lessened; (3) there is less pulmonary irritation; (4) nausea and vomiting are less marked.

Certain rules must be followed for the successful use of this type of anesthesia. These are: (1) watchfulness at all times; (2) the variation of dosage according to the case; (3) the administration of a laxative two nights before the operation; (4) high colonic irrigations twenty-four, twelve and two hours before operation; (5) good sleep and light diet the day before.

The administration is carried out in the patient's room. One hour before administration, morphine and atropine is given hypodermically. Sometimes paraldehyde is added to the ether-oil mixture.

The danger signs are: (1) collapse of the patient during administration; (2) a rapid fall of reflexes; (3) cyanosis; (4) embarrassed respiration.

In cases where absorption is slow, some ether by mouth may be necessary. The after-care involves the removal of the unabsorbed solution and flushing of the bowel by colonic irrigation.

Discussion. Dr. Francis Clark Grant has used this method in 90 neurosurgical cases with very gratifying results. Usually 2 ounces of ether mixed with the proper amount of oil, given an hour before operation, gives adequate analgesia for spinal cord and head cases. This is usually reinforced by having the same mixture given during the operation by Murphy drip. In head and spinal cases, local novocaine infiltration is used in addition to the colonic ether.

DECEMBER 19

The Cerebral-cisternal-spinal Lavage Method of Treatment of Septic Meningitis, and the Intracarotid Treatment of Experimental Pneumococcus Meningitis

Dr. John A. Kolmer said that septic meningitis refers to that caused by pneumococci or streptococci, and usually arising from middle ear, mastoid or paranasal sinus infections. Strictly localized

meningitis by these organisms may be recovered from, but the diffuse, spreading types with purulent cerebrospinal fluids still carry a mortality of nearly 100 per cent and constitute infections among the most mortal afflicting mankind. And their frequency, aside from this dreadful mortality, demands increasing efforts toward the evolvement of more efficient methods of prevention and treatment.

Diagnosis is frequently and indeed usually greatly delayed. In the opinion of Dr. Kolmer *a culture on blood agar or in glucose hormone broth should be made routinely in every mastoid case at the time of operation* and an exact bacteriologic diagnosis demanded. If pneumococci or streptococci are present, a specially careful watch for meningitis should be maintained, and if this dreaded complication developes, diagnosis is already greatly aided. Furthermore, *in pneumococcus infections it is possible that the intramuscular injection of* 25 *to* 50 *cc. of pneumococcus antibody solution or anti-pneumococcus serum may possess prophylactic power, especially in Type I infections*, even though passage of antibody into the cerebrospinal fluid may not occur and is indeed not to be expected. This would appear to be an acceptable practice in all severe pneumococcus infections of the mastoids at least.

In the experience of the speaker, however, carefully conducted spinal puncture and the *slow* removal of a few cubic centimeters of cerebrospinal fluid for microscopic inspection and laboratory examination have been without discernible harm. It may be that clumsy technic, including the use of unnecessarily large needles and the rapid removal of unnecessarily large amounts of fluid, may favor the spread of a localized patch of meningitis or the localization in the meninges of organisms in the blood, but he is reasonably sure that gentle puncture with a gauge 16 to 19 needle and the slow removal of 5 cc. of fluid, ample for all diagnostic tests, has not produced either result. Nor has he been able, in the case of dogs, to experimentally localize pneumococci from the blood into the meninges by simple spinal punctures and the withdrawal of even large amounts of spinal fluid, corresponding to as much as 1 to 2 cc. per kilogram of weight.

Dr. Kolmer has definitely demonstrated, by treatment of experimental meningitis in a large series of dogs, that the intraspinal injection of various medicaments, associated with the intravenous administration of bactericidal substances or of pneumococcus anti-

body solution, will not cure a definitely established septic meningitis of a pneumococcic or a streptococcic type. He believes that generalized pneumococcus and streptococcus meningitis are practically 100 per cent fatal, and that unless radical forms of treatment are attempted as early as possible there is little hope of saving the patient's life.

He has tried intravenous injections of optochin, mercurochrome, mercurophen, metaphen, gentian violet, acriflavin, rivanol and Pregel's iodine, without the slightest effect; also intramuscular and intravenous injections of pneumococcus antibody solution and serum and polyvalent antistreptococcus serum. It may be that these substances are helpful in combating toxemia and bacteremia, but are without demonstrable effect upon the course and outcome of experimental septic meningitis. He has also used all of them, excepting rivanol, in the treatment of human infections without success.

Dr. Kolmer has used optochin, mercurochrome, mercurophen, metaphen, gentian violet, acriflavin and rivanol intraspinally with similar disappointing results in the treatment of experimentally produced infections; also optochin, mercurophen and gentian violet in human infections without results.

With such results and experiences, he abandoned all hope of conquering septic meningitis by chemotherapeutic and biologic therapy, or a combination of these, until such time when more powerful antipneumococcic and antistreptococcic agents *in vivo* were discovered, and turned hopefully to the subject of surgical drainage as a method of treatment since Hill, Dandy, Rainey and Aford, Eagleton and others had reported some encouraging results from drainage by laminectomy, cisternal puncture or more radical procedures.

In view of the difficulty and the impossibility of bringing antibacterial agents in contact with all of the infected meninges in severe diffuse meningitis by this quadruple method of injection, and especially when the exudates are purulent and plastic, Dr. Kolmer has tried the treatment of experimental pneumococcus meningitis of dogs by the injection of pneumococcidal agents into both common carotid arteries. The injection of gentian violet and other dyes has shown an intense and widely distributed concentration of inoculum in the cerebral and basilar meninges, reaching as far as the upper part of the cord along with the passage of a portion into the cerebrospinal fluid.

About 60 per cent of dogs were cured, when treatment was instituted upon the onset of signs and symptoms of meningitis, following intracisternal injections of virulent Type I pneumococci under the following plan: (1) ether anesthesia; (2) puncture of the cisterna magna and removal of purulent fluid, needle left in position; (3) the injection of 1.0 cc. of pneumococcus antibody solution or anti-pneumococcus serum with optochin (25 cc. of former with 1 cc. of 1 to 100 optochin hydrochloride) into each common carotid artery per kilogram of weight; (4) the intracisternal injection of 3 cc. of the mixture per dog (3 to 5 kilograms body weight), followed by withdrawal of the needle.

So far the method has not been tried in human beings, as the laboratory studies up to this point have just been completed, but he thinks it is worthy of trial. It is to be emphasized, however, that the treatment was instituted early in the course of the disease, but only when meningitis was present with cloudy cisternal fluids teeming with cocci.

Discussion. Dr. B. A. Randall stated that for fifteen years he has advocated lavage of the subarachnoid space, and by so doing has had one or two recoveries for generalized meningitis. It is worthwhile to combine this lavage with saline hypodermoclysis.

Dr. S. MacCuen Smith was especially interested in the statement of Dr. Kolmer that spinal punctures, if carefully performed, was not followed by spreading of the meningitis. A spinal puncture is essential for an early diagnosis. Years ago cisternal drainage was advocated by Dr. Haines. Dr. Smith performed cisternal operations on 3 cases, all of which died. He feels that cases of this sort require more than simple drainage.

Dr. George B. Wood asked if drainage of the cisterna brings antibodies into the spinal fluid.

Dr. Kolmer, in closing, said that drainage alone did not produce results. Perhaps it does influence the passage of antibodies into the subarachnoid space. The best results can be obtained by intracarotid injection combined with cisternal drainage and lavage.

Acute Mastoiditis Accompanied by Lateral Sinus Thrombosis and Multiple Brain Abscess

Dr. John R. Davies reported a case of acute bilateral mastoiditis, sinus thrombosis and multiple brain abscess in a child, aged two years. The interesting points were (1) that the symptoms of meningeal inflammation were referred to the right ear, which had shown very few symptoms, the left one having been operated on for mas-

toiditis and left lateral sinus thrombosis; (2) the discovery of an extradural abscess on operation on the right mastoid; (3) the failure of repeated eye-ground examinations to help in the diagnosis; (4) the finding of a pneumococcus in the pus of both mastoids and a hemolytic streptococcus in the lateral sinus; blood cultures and repeated cultures of the spinal fluid were negative; (5) the demonstration of left lateral sinus thrombosis by the Ayer-Toby test; (6) autopsy showed a purulent leptomeningitis over the whole brain, with a subdural collection over the right temporosphenoidal lobe. In addition to this there were multiple subcortical abscesses and pus in each lateral ventricle.

Discussion. Dr. Merritt Stiles (by invitation) raised the following questions: (1) Could this serious condition have been avoided by early myringotomy? (2) Would pneumococcic antibody solution have been of value? (3) Were the swellings on the child's body due to streptococcic infection?

Dr. George B. Coates said that he had heard an excellent discussion on multiple brain abscess this summer while attending the British Medical Association. Dr. Coates has probably had 4 cases of this type, although they are usually considered very rare.

Dr. S. MacCuen Smith said that turning out the clot of the thrombosed sinus alone is not sufficient to produce bleeding, and if the clot can be dislodged and good bleeding secured from below and then from above, it may be unnecessary to ligate the jugular. In the average case, however, it is probably better to ligate.

Dr. B. A. Randall has noticed that acute cases almost always have a pneumococcus present. In his opinion the jugular bulb in children is usually the initial site of thrombosis. In acute cases this phlebitis and thrombosis is largely self-limiting. In chronic cases, pus is almost always formed. The recognition of brain abscess is often very difficult and localizing signs are absent. One of the most valuable symptoms of abscess of the cerebellum is the appearance of atrophic conditions of the lower extremities.

The Nature of Nystagmus and Dizziness Occurring in Certain Positions of the Head and in Movements Other than Those Around the Long Axis of the Body

Dr. Joseph C. Yaskin (by invitation), said that 50 consecutive cases were investigated in an otologic clinic in Vienna to determine the occurrence of nystagmus and vertigo in certain positions of the head and in head movements other than those around the long axis of the body. Of these, 12 cases had combined nystagmus and vertigo, and 7 only vertigo; 31 gave no response.

No etiologic relationship could be established between these phenomena and any clinicopathological condition in our patients: of the 19 cases, all except 1 had normally irritable labyrinths; 10 cases had cochlear hypofunction and 7 chronic middle-ear processes, forming no striking contrast with the 31 cases which did not reveal either nystagmus or vertigo.

Our investigations would assign the immediate cause of these phenomena to increased susceptibility of the semicircular canal component of the labyrinth. This does not mitigate against the occurrence of these signs in lesions of the brain-stem and the parts of the central nervous system, as reported in literature. In these cases, however, there was no evidence of any such lesions.

These two signs *by themselves* are not indicative of a serious condition either in the peripheral ear or in the brain-stem. In themselves, they are not sufficient indications for establishing diagnosis of a serious condition either in ear or brain-stem and are not indications for surgical interference.

Discussion. Dr. Robert Hunter has found that nystagmus with the head in unusual positions is not uncommon. Some time ago he reported one of these cases after disease of the otolith apparatus. Probably this case was merely one of nystagmus occurring due to change of position of the head. Three cases were cited that developed vertigo or nystagmus when the head was placed in certain positions: 1 improved spontaneously; 1 after tonsil removal, and the third was not followed. Probably the semicircular canals are closely associated and the action of one affects the other.

PROCEEDINGS

OF THE

SECTION ON GENERAL MEDICINE

PAPERS READ DURING 1928

JANUARY 30

Dr. Joseph Sailer, "General Infection with the Bacillus Aërogenes Capsulatus: a Report of Two Cases."

Dr. Joseph Sailer, "A Case of Pulsating Spleen in Aortic Insufficiency."

Dr. Franz Groedel, Frankfort-on-the-Main, Germany (by invitation), "Some New Diagnostic Possibilities by Examination of the Heart and Lungs with *X*-ray."

FEBRUARY 27

Dr. Edward Weiss and Dr. Baxter L. Crawford, "A Consideration of Leukemia, with Especial Reference to a Subacute Form."

Dr. Fred Kalteyer, "An Interpretation of the Pain Mechanism of Angina Pectoris."

MARCH 26

Dr. Richard A. Kern, "Bacillus Abortus Infection in Man, with Report of a Case."

Dr. Louis Tuft (by invitation), "Insulin Hypersensitiveness: Immunological Consideration, with Case Reports."

Dr. Jay F. Schamberg, "The Effect of Extremely Hot Baths on Experimental Syphilis in the Rabbit and on Human Syphilis."

APRIL 23

Dr. Julius Bauer, Vienna (by invitation), "New Aspects in the Pathology and Treatment of Obesity."

MAY 28

Dr. J. Alexander Clark, Jr., "Tuberculous Pericarditis: A Report of Two Cases."

Dr. Joseph V. Klauder, "Experimental Studies in Eczema."

Dr. Russell Richardson, "High Carbohydrate Diets in Diabetes."

Dr. Leon Jonas, "Benign or Nondiabetic Glycosuria: Its Differentiation from Diabetes."

Dr. George Wilson and Dr. Samuel B. Hadden (by invitation), "The Treatment of General Paresis."

OCTOBER 22

Dr. Robert L. Pitfield, "A Simple Method for Reinforcing Reflexes, Especially the Hoffman Reflex."

Dr. John H. Arnett, "Alcoholic Epilepsy."

Dr. Reginald Burbank (by invitation), "The Etiology of and Experimental Production of Arthritis."

Dr. J. Harold Austin and Dr. F. W. Sunderman (by invitation), "Effect of Feeding Sodium Chloride in Lobar Pneumonia."

NOVEMBER 22

Dr. Edward Weiss, "Ulcerative Endocarditis of the Pulmonic Cusps."

Dr. W. O. LaMotte (by invitation), "Acute Infectious Mononucleosis from the Viewpoint of an Otolaryngolosist: Report of Three Cases."

Dr. J. A. Bargen (by invitation), "Ulcerative Colitis."

DECEMBER 20

Dr. Charles W. Burr, "Prefatory Remarks."

Motion Picture, "Mechanics of the Brain," depicting the brilliant experiments in the physiological background of human behavior, based on the researches of Prof. Ivan P. Pavlov, Director of the Physiological Laboratories in the Russian Academy of Science.

PROCEEDINGS

OF THE

SECTION ON PUBLIC HEALTH AND INDUSTRIAL MEDICINE

PAPERS READ DURING 1928

MAY 11

Dr. Charles E. North, New York City (by invitation), "Clean Milk."

Mr. C. I. Cohee (by invitation), "Philadelphia's Milk Supply."

NOVEMBER 23

Dr. George Morris Piersol (by invitation), "Conserving the Health of Women in Industry."

Dr. Henry Field Smyth, "Volatile Solvents as Health Hazards in Industry."

PROCEEDINGS

OF THE

SECTION ON MEDICAL HISTORY

PAPERS READ DURING 1928

JANUARY 17

Dr. James Hendrie Lloyd, "Sir Thomas Browne and the Witches."

Dr. David Riesman, "The Story of Glozel."

Dr. Lawrence F. Flick, "The History of the Origin of the Henry Phipps Institute of Philadelphia."

FEBRUARY 21

Dr. C. N. B. Camac, New York City, "The Edwin A. Smith Papyrus." (The oldest known scientific writings.)

Prof. Henry Fairfield Osborn, New York City, "Recent Discoveries Concerning the Ancestry of Man."

APRIL 17

Dr. Charles W. Burr, "Dr. James and his Medical Dictionary."

Dr. Victor Robinson, New York City (by invitation), "Berzelius."

Dr. John C. Hemmeter, Baltimore (by invitation), "The History of the Canon of Human Proportions from Polyclitus to Leonardo Da Vinci and Albrecht Dürer."

OCTOBER 16

Dr. Robert L. Pitfield, "A Pitiful, Tottering, Gasping, Staggering Tomfool."

Dr. Edward A. Strecker, "The Pennsylvania Hospital, the Cradle of American Psychiatry."

NOVEMBER 20

George H. Meeker, Ph.D., Sc.D. (by invitation), "Friedrick Wöhler and a Biologic Milestone."

Dr. Francis Heed Adler, "Sketches from the Life of Albrecht von Graefe, 1828–1870."

Dr. Joseph Franchini, Bologna, Italy (by invitation), "Life and Work of Marcello Malpighi." (Illustrated by letters, instruments, books and medals.)

DECEMBER 4

Dr. Charles W. Burr, "Dr. Robert Whytt and Internal Hydrocephalus."

Mr. H. W. Carson, London, England (by invitation), "Surgery during the Period 1770–1820."

DECEMBER 18

Dr. John B. Deaver, "What Attributes go to Make a Surgeon."

Dr. William Darrach, New York City (by invitation), "Skyscrapers in Medicine."

Dr. Hobart A. Hare, "What the Student of Today Should Strive For."

ANNUAL REPORT OF THE LIBRARY COMMITTEE FOR 1928.

Mr. President: In accordance with the ordinances and By-Laws of the College, I herewith submit the following report of the Library Committee for the year 1928:

Total number of volumes in the Library, including the bound volumes and 23,739 unbound "Reports" and "Transactions"	158,041
Number of unbound "Theses" and "Dissertations"	30,771
Number of unbound Pamphlets	169,898
Manuscripts	435

Included in the above are 4385 volumes known as "Reserves," consisting of second copies of some of the more important periodical publications; also 2922 volumes more or less incomplete.

The duplicates, which number 4842 at this date, are not included in the above total.

The following table shows the number of volumes in the various divisions of the Library:

	Bound.	Incomplete and unbound.	Total.
General Library	113,392	2,875	116,267
Lewis Library	13,829	44	13,873
On permanent deposit:			
S. D. Gross Library	3,752	3	3,755
Library of the Obstetrical Society of Philadelphia	217	0	217
Mütter Museum*	190	0	190
			134,302

Received during the year from all sources, 3651 volumes, 11,782 pamphlets and 16,731 numbers of various periodicals.

* The books of the Mütter Museum are not permitted to be removed from the College building.

Divided as follows:

	Volumes.	Pamphlets.	Journals.
General Library	2,739	11,707	15,677
Lewis Library	15		
S. D. Gross Library	13		
By purchase, General Account	528		
In exchange	356	75	1,054
	3,651	11,782	16,731

Accessions (including 20 volumes of "Reserves"), 2667.

	Volumes.
General Library	2,639
Lewis Library	15
S. D. Gross Library	13
	2,667

Total increase in the number of volumes for the year: 2667.

Photographs received in response to requests sent out during the past year and voluntary gifts: Fellows of the College, 5; other than Fellows, 10.

Total number of portraits listed to date, 14,022.

The individual "Donors" for the year ending November 1, 1928, number 446; this represents 996 distinct presentations. Each gift is duly acknowledged.

The following list shows individual gifts of twenty volumes and over; also the number of volumes presented by the various publishing houses:

	Volumes.
Presbyterian Hospital	560
Dr. Frank Woodbury	88
Dr. James D. Seiberling	80
University of Pennsylvania Department of Pathology	63
Dr. E. R. Sausser	38
Dr. Elliston J. Morris	26

From the publishing houses of:

	Volumes.
P. Blakiston's Son & Co.	20
F. A. Davis Company	23
Lea & Febiger	17
J. B. Lippincott Company	19
W. B. Saunders Company	56

The Library is indebted for large gifts of pamphlets and unbound periodicals to the following donors:

Dr. H. B. Allyn
Dr. A. P. C. Ashhurst
Biological Abstracts
P. Blakiston's Son & Co.
Dr. Charles W. Burr
Dr. A. A. Cairns
Dr. Burton Chance
Dr. Francis X. Dercum
Dr. W. A. Newman Dorland
Dr. Thomas H. Fenton
Dr. Henry M. Fisher
Dr. Lawrence F. Flick
Dr. J. P. C. Griffith
Dr. Hobart A. Hare
Dr. Addinell Hewson
Mr. Paul B. Hoeber
Dr. John H. Jopson
Dr. C. F. Judson
Dr. W. W. Keen
Dr. B. Kohn
Dr. E. B. Krumbhaar
Dr. George C. Kuesel
Dr. Joseph Leidy
J. B. Lippincott Company
Dr. Joseph McFarland
Dr. G. M. Marshall
Dr. Edward Martin
Dr. Charles K. Mills
Dr. S. W. Moorhead
Dr. Elliston J. Morris
Dr. John R. Paul
Philadelphia Bureau of Health
Presbyterian Hospital
Dr. Joseph Sailer
Dr. Paul J. Sartain
Dr. G. E. deSchweinitz
U. S. Public Health Service
U. S. Department of Agriculture
University of Pennsylvania
Department of Pathology
Dr. Joseph Walsh
Dr. James C. Wilson
Dr. C. S. Witherstine

850 new publications were added to the Library during the past year; viz.: United States, 327; Great Britain and Colonies, 246; France, 73; Germany, 185; Italy, 3; all other countries, 16. Of these new publications, 34 were written or edited by Fellows of the College.

21 volumes were presented by the following authors or editors:

Drs. Maud E. Abbott and Edward Weiss
Dr. Astley P. C. Ashhurst
Dr. Charles D. Ball
Dr. Lewellys F. Barker
Dr. Israel Bram
Dr. Thomas S. Cullen
Dr. Charles L. Dana
Dr. John H. Gibbon
Dr. Hobart A. Hare
Dr. Georges Jeanneney
Dr. Howard A. Kelly
Dr. Geoffrey Keynes
Dr. William L. Mann
Dr. Hiram W. Orr
Dr. William A. Pusey
Dr. William D. Richardson
Dr. George E. deSchweinitz
Dr. George H. Sherman
Dr. Ralph W. Webster
Dr. William A. Williams

3 volumes were sent by the publishers at the request of the following authors or editors:

Dr. Durán Arrom
Drs. Solomon Solis-Cohen and Thomas S. Githens
Dr. William W. Keen

Summary of the "Funds:"

	Volumes purchased.	Cost.
Henrietta Rush Fales Baker Fund	34	$192.39
Luther S. Bent Fund	14	51.68
William T. Carter Fund	7	
Gerardus Clarkson Fund	18	56.87
Francis X. Dercum Fund	57	238.76
Louis A. Duhring Fund	46	251.62
John D. Griscom Fund	90	299.65
Richard H. Harte Fund	35	347.05
Charles T. Hunter Fund	6	36.26
William F. Jenks Fund	64	290.17
Oliver A. Judson Fund	14	63.68
William V. and John M. Keating Fund	18	62.92
William W. Keen Fund	46	215.59
Library Endowment Fund	133	488.20
Horace Magee Memorial Fund	142	752.08
J. Ewing Mears Fund	40	168.77
Charles K. Mills Fund	2	3.33
Weir Mitchell Fund	71	252.55
E. E. Montgomery Fund	31	134.63
John H. Musser Fund	7	28.07
Elizabeth K. Newcomet Fund	10	45.16
William F. Norris Fund	35	224.72
Charles A. Oliver Fund	9	52.60
Philadelphia Medical Society Fund	6	
Lewis Rodman Fund	32	245.92
Douglas Stockton Warren Fund	34	145.73
John F. Weightman Fund	12	59.31
J. William White Fund	31	169.75
Caspar Wistar Fund	57	255.43
	1,101	$5,132.89
From the General Account—by purchase	528	$6,967.61

Special accounts:

	Volumes purchased.	Cost.
Fund for completing files of journals	125	$554.45
Fund for rare and valuable books	54	1,769.88
S. D. Gross Library	10	287.76

	Expended.
Catalogue Endowment Fund—on account of salaries . .	$46.50
Louis A. Duhring Fund—for general purposes of the Library	13,000.00
Morris Longstreth Fund—on account of salaries . . .	1,107.00
George B. Wood Fund—Library supplies, stationery, etc. .	267.32

Number of volumes bound, 1953.

	Visitors.	Fellows.	Total.
Use of the Library	6,938	1,749	8,687

The Library has been kept open two evenings each week and on the five minor legal holidays for the same period of time as during the previous year:

Evenings.	Visitors.	Fellows.	Total.
79	961	156	1,117
Legal holidays.	**Visitors.**	**Fellows.**	**Total.**
5	136	31	167

These figures are included in the total given for the year.

	1928.	1927.	Decrease.
Number of volumes consulted in the Library	23,377	25,363	1,986

The number of books "consulted in the Library" includes only those supplied on demand. Readers have access to the bound volumes of periodicals and works of reference kept on the shelves in the Reading Room, and the Fellows of the College have access to the Book Stacks. There are, therefore, many volumes consulted of which no accurate record can be kept.

	1928.	1927.	Increase.
Number of volumes taken out .	4,755	4,449	306

Use of Study Rooms: Average number of rooms in use throughout the year, 4. Greatest number in use at one time, 6. Daily average of the number of volumes in use in these rooms, 92.

	Works.	Volumes.	Cards written.	Printed cards revised.
Cataloguing . . .	1,123	1,152	5,442	2,588

All books added to the shelves during the past year and 361 of the more important pamphlets have been catalogued and shelf-listed;

and all bound volumes, including periodicals, transactions and reports, have been accessioned.

Revision of the Catalogue: 6256 cards have been revised, rewritten and filed.

3917 unbound pamphlets and reprints have been subject-headed and arranged alphabetically by subject and by author under the subject.

We have listed November 1, 1928, 1372 current periodical publications including "Transactions" and "Reports," obtained through the following sources:

	American.	Foreign.
Endowment Funds	73	343
By purchase from General Account	57	224
In exchange	68	157
Editors	115	38
Publishers	78	18
Through the courtesy of the Editor of the late *Therapeutic Gazette*, which has ceased publication	23	12
	414	792
Reports, not included in the above	132	34
	546	826

The actual number of periodicals received during the year including new subscriptions (6 American, 11 foreign), total 1206.

The following is a list of the foreign schools of medicine with which we exchange publications at the present time:

University of Amsterdam
" Basel
" Berlin
" Bonn
" Breslau
" Erlangen
" Geneva
" Giessen
" Göttingen
" Halle
" Heidelberg
" Kiel
Faculty of Medicine of Paris
University of Königsberg
" Lausanne
" Leiden
" Leipzig
" Liège
" Lund
" Marburg
" Rostock
" Strassburg
" Upsala
" Utrecht
" Würzburg
Faculty of Medicine of Toulouse

During the past year we have heard from Amsterdam, Basel, Berlin, Bonn, Breslau, Erlangen, Giessen, Göttingen, Halle, Heidelberg, Kiel, Königsberg, Lausanne, Leiden, Leipzig, Lund, Rostock, Upsala, Utrecht, Würzburg and Paris.

1,371 dissertations and 319 theses have been added to our collection.

We have received in cash from the sale of duplicates for the current year ending November 1, 1928, $285.64.

We have distributed books and journals on exchange account to the following:

Barlow Medical Library, Los Angeles, California
Boston Medical Library
College of Physicians and Surgeons, New York
A. W. Calhoun Medical Library, Emory University, Georgia
Medical and Chirurgical Faculty, Baltimore
Medical Society, County of Kings, Brooklyn
New York Academy of Medicine
Presbyterian Hospital, Philadelphia
St. Luke's Hospital, Chicago
University of California Medical School, San Francisco

We have received exchanges from:

Boston Medical Library
College of Physicians and Surgeons, New York
Iowa State Library, Des Moines
Medical Society, County of Kings, Brooklyn
New York Academy of Medicine
Presbyterian Hospital, Philadelphia
St. Luke's Hospital, Chicago
Toledo Hospital, Toledo, Ohio
University of California Medical School, San Francisco
Washington University School of Medicine

Several of the exchanges on the above list were made through the Medical Library Association.

With the aid from exchanges, and purchases made with funds appropriated by the Library Committee, we have been able to complete the files of the following journals:

Berichte über die gesamte Gynäkologie und Geburtshilfe, Berlin
Il Cervello—Giornale di Nevrologia, Napoli
Journal of Balneology and Climatology, London
Schweizerische Zeitschrift für Medicin, Chirurgie und Geburtshülfe, Bern

Amount of fines collected for the current year ending November 1, 1928, $127.30.

List of rare medical books and works of special interest received during the year: (These rare books have been acquired without in any way interfering with the purchase of current medical publications.)

INCUNABULA

[Total number of incunabula at this date, 379 Titles, 365 Volumes]

Aeneas Sylvius postea Pius II Max. Epistoles familiares.*** Norimbergae, Antonius Koburger s. Koberger, Norimbergensis, 1486. [Hain 154.]

Fund for Rare Books.

Augustinus, S. Aurelius. Sermones ad Heremitas.*** [Argentorati, Martin Flach, s. Simus Basiliensis, circa 1475.] [Hain 1997.]

[*Gesamtkatolog der Wiegendrucke no. 3002 says Strassburg (Argentorati, Johannes Prüss (Pryss), nicht noch 1487.*]

Fund for Rare Books.

Fulgosus, Baptista. Anteros.*** Mediolani, Leonhardus Pachel, 1496. [Hain 7393.]

Fund for Rare Books.

Ockam, Guilielmus Ordin. Minor. Summulae in Aristotelis physicam.*** Bononiae, Benedictus Hectoris, Bononiensis, 1494. [Hain 11951.]

Fund for Rare Books.

Petrarca, Franciscus. Epistolae familiares. Venetiis, Joannes et Gregorius de Gregoriis, 1492. [Hain-Copinger 12811.]

Fund for Rare Books.

Phalaris. Epistolae*** Francisci Arretini(sic) in Phalaridis Tyranni Agrigentini Epistolas Proemivm. [Bononiae, Balthasar Azzoguidus, circa 1480.] [Reichling II. 676.]

[*Bound with—Petrarca, F. Epistolae familiares. 1491.*]

Fund for Rare Books.

de Roselli Aretinus, A. Tractatus de ieiuniis. [Romae, Bartholomaeus Guldinbeck de Sultz, circa 1475.] [Reichling 311.]

Fund for Rare Books.

Brunschwig, Hieronymus. Das Buch der Cirurgia. Strassburg, Johann Grüninger, 1497. Begleit-Text von Gustav Klein. München, Kuhn, 1911.

[*Facsimile.*]

Fund for Rare Books.

Works of Special Interest

Albucasis. Liber theoricae necnon practicae Alsaharavii in prisco Arabum medicorum conuentu facile principis; qui vulgo Acararius dicitur; iam summa diligentia et cura depromptus in lucem. Auguste Vindelicorum, Sigismund Grimm et M. Vuirsung, 1519.

Fund for Rare Books.

ab Altomari, Donatus Antonius. Omnia, quae hucusque in lucem prodierunt, Opera, nunc primum in unum collecta, et ab eodem auctore diligentissimé recognita et aucta: cum locis omnibus in margine additis.*** Lvgdvni, Apud Guilielmum Rovillium, 1565.

Ex libris Gabrilis Caroli leClerc Doctor. Med. et Regis ord. 1692.

Fund for Rare Books.

Amar, Joseph. Instruccion curative de las viruelas dispuesta para los facultativos y acomodada para todos. Madrid, Ibarra, 1774.

Fund for Rare Books.

Antero, Maria da S. Bonaventura. Lazaretti della città e riviere di Genova del MDCLVII.*** Genova, Pietro Giouanni Calenzani, e Francesco Meschini, 1658.

Fund for Rare Books.

Aristoteles. De virtutibus libellus, nuper quidem graece inventus, iam vero primum per Simonem Grynaeum latinitute donatus. Cum exactiore quadam virtutum divisione per eundem Simonen Grynaeum. Basel, Robert Winter, 1539.

[*Bound with—Magnus, N. De medicis pulveribus libellus. 1545.*]
[*First Greek and Latin edition. In original vellum.*]

Fund for Rare Books.

Aristotle (Pseudonym). New Aristotle's master-piece, or a complete display of the wonderful operations of nature.*** Being partly a new translation from the original Greek***by W. M. Rickemy. [London, 1750.]

Fund for Rare Books.

Arnold, Joh. Wilh. Die Lehre von der Reflex-Function für Physiologen und Aerzte. Heidelberg, Groos, 1842.

Fund for Rare Books.

Arnoldus de Villa Nova. Liber de co[n]servanda iuue[n]tute et retardanda senectute. Liber de conferentibus et nocentibus principalibus membris nostri corporis. Lip[siae] Wolfgang Monacensis, 1511.

[*MSS. notes.*]

Fund for Rare Books.

Banester, John. Historie of man, sucked from the sappe of the most approved anathomistes, in the present age.*** London, Daye, 1578.

Fund for Rare Books.

Bauhinus, Caspar. Theatri botanici in quo plantae supra sexcentae ab ipso primum descriptae cum plurimis figuris proponunter. Editio altera emendatior. Basileae, Regis, 1671.

*[Bound with his—Theatri botanici sive index in Theophrasti Dioscoridis, Plinii et botanicorum.*** 1671.]*

Fund for Rare Books.

Beverovicius, Joh. Idea medicinae veterum. Lugd. Batav., ex off. Elseviriorum, 1637.

Fund for Rare Books.

Cheyne, George. Remarks on two late pamphlets written by [Charles] Oliphant, against [Archibald] Pitcairn's dissertations and the new theory of fevers. Edinburgh, 1702.

Fund for Rare Books.

Cotugno, Dominico. De sedibus variolarum ΣΥΝΤΑΓΜΑ. Viennae, apud Rudolph Graeffer, 1771.

Fund for Rare Books.

Deusingius, Antonius. Sympathetici pulveris examen.*** Groningae, Typis Johannis Cölleni, 1662.

Fund for Rare Books.

Dioscorides Anazarbeus, Pedacius. De medicinali materia libri novem, Joanne Ruelio interprete. Bologna, Cynthius Achillinus, 1526.

With pretty historical woodcut border round the title, a few nice woodcut initials on black ground and a curious device at the end showing a flying tortoise above a sacrificial altar. [Manuscript notes.]

Fund for Rare Books.

Ficinus Florentinus, Marsilius. Tractatus de epidimiae morbo, ex Italico in Latinum versus. Augustae Vindelicorum, Grimm, 1518.

Fund for Rare Books.

Forestus Alcamarianus, Petrus. Observationum et curationum chirvrgicarvm libri quinque, de tvmoribus praeter natvram. [Lugd. Batav.] Ex officina plantiniana Raphelengii, 1610.

*Also his—Observationum et curationum chirurgicarum libri quatuor posteriores de vulneribus, ulceribus.*** 1610.*

Fund for Rare Books.

Gall, Franz Joseph. Cranologie, ou découvertes nouvelles, concernant le cerveau, le crâne, et les organes.*** Paris, Nicolle, 1807.

Fund for Rare Books.

Gautier d'Agoty [Jacques Fabian]. Exposition anatomique des organes des sens, jointè à la névrologie entiere du corps humain, et conjectures sur l'électricité animale.*** Paris, Chez Demonville, 1775.

Presented by Doctors A. P. C. Ashhurst, John B. Deaver, John H. Gibbon, George P. Müller, and William J. Taylor.

Gautier d'Agoty [Jacques Fabian]. Exposition anatomique des maux vénériens, sur les parties de l'homme et de la femme, et les remedes les plus usitès dans ces sortes de maladies. Paris, Brunet, 1773.

Fund for Rare Books.

[*The above two books show some of the earliest examples of colored plates in the illustration of the works mentioned.*]

Glauber, Joh. Rudolf. De l'oevvre minerale, ou est enseignée la separation de l'or des pierres á feu, sable, argile, et autres fossiles, par l'esprit de sel, ce qui ne se peut faire par autre voye.*** mise en françois par Du Teil. Paris, Jolly, 1659. 3 volumes in 1.

Fund for Rare Books.

Harcouet de Longueville. Histoire des personnes qui ont vecu plusieurs siecles et qui ont rajeuni, avec le secret du rajeunissement, tiré d'Arnauld de Villeneuve. Paris, Charpentier, 1715.

Fund for Rare Books.

Harvey, Gideon. Art of curing diseases by expectation; with remarks on a supposed great case of apoplectik fits. Also most useful observations on coughs, consumptions.*** London, Partridge, 1689.

Fund for Rare Books.

Hedges, Phinehas. Strictures on the elementa medicinae of [John] Brown. Goshen, Westcott, 1795.

[*Early American comment on the Brunonian theory.*]

By Purchase.

Hiltprandus, Johannes. Regiment; Wie sich allerley Stände Jung unnd Alt Manns und Frawens Personen in diesen gefehrlichen Zeiten von der Pestilenz.*** Pataviae, 1583.

Horace Magee Memorial Fund.

Jones, John. Novarum dissertationum de morbis abstrusioribus tractatus primus de febribus intermittentibus in quo obiter febris continuae natura explicatur. Londini, Pauli, 1683.

Fund for Rare Books.

Joubert, Laurent. Medicinae practicae priores libri tres, quibus accesserunt. Lugduni, apud Antonium de Harsy, 1577.

[*Also his—Isagoge therapeutices methodi.****]

[*The two works are rarely found together.*]

Fund for Rare Books.

Leveling, H. P.: Anatomische Erklärung der Original-Figures von Andr. Vesal samt Anwendung der Winslowischen Zergliederungslehre. Inglstadt, Attenhouer, 1783.

[*Engraved title page.*]

Fund for Rare Books.

Lawrence, Thomas. Franci Nichollsii, M.D.,*** vita, cum conjecturis de natura et usu partium humani corporis similarium. Londoni, 1780.
Fund for Rare Books.

Magnus, Nicolaus. De medicis pulveribus libellus. Paris, Michael Vascosanus in aedibus Simonis Colinaeus, 1545.
[*Bound with—Aristoteles. De virtutibus libellus.*** 1539.*]
[*Not recorded by Ebert and Brunet.*]
Fund for Rare Books.

Manni, Domenico Maria. Degli occhiali da naso inventati da Salvino Armati. Trattato istorico. Firenze, Anton Maria Albizzini, 1738.
With nice engraved title-vignette and several wood-cut initial letters. Original half vellum. Fine copy with very wide margins.
Fund for Rare Books.

Massieu [Jean] and Clerc. Collection of the most remarkable definitions and answers of Massieu and Clerc, deaf and dumb, to the various questions put to them, at the public lectures of the Abbé Sicard, in London.*** With notes and an English translation by J. H. Sievrac. London, Cox, 1815.
[*French and English text.*]
Fund for Rare Books.

Melius inquirendum; or, An answer to [Charles] Olyphant's discourse of the usefulness of vomiting in fevers. Edinburgh, Vallange, 1699.
Fund for Rare Books.

Nicholls, Frank. De natura et usu partium humani corporis similarium. Londini, 1780.
[*This book was never published and only one hundred copies printed.*]
Fund for Rare Books.

Petit-Radel Ph[ilippe]. Institutions de médecine, ou exposé sur la théorie et la pratique de cette science, d'après les auteurs anciens et modernes, ouvrage didactique, contenant les connaissances générales, nécessaires à ceux qui se distinent à exercer l'art de guérir. Paris, Chez Agasse, an IX [1802]. Volume 1.
Fund for Rare Books.

Salernum, School of. De conservanda bona valetvdine, opvscvlvm scholae Salernitanae, ad regem Angliae, cum Arnoldi Nouicomesis, medici et philosophi antiqui enarrationibus vtilissimis, novissime recognitis et auctis per Ioannem Curionem.*** Venetiis, Apud Haeredes Melchioris Sessae, 1567.
Fund for Rare Books.

Smyth, J[ames] Carmichael. An account of the effects of swinging, employed as a remedy in the pulmonary consumption and hectic fever.*** London, Johnson, 1787.
Fund for Rare Books.

Sydenham, Thomas. Entire works of Thomas Sydenham. Newly made English from the originals. [Translated by John Swan.] London, Cave, 1742.

Fund for Rare Books.

Theatrum sympatheticum auctum, exhibens varios authores de pulvere sympathetico.*** Norimbergae, apud Johan. Andreas Endterum. et Wolfgangi, 1762.

Fund for Rare Books.

Useful transactions for the months of May, June, August and September, 1709. Containing a voyage to the Island of Cajamai in America. Giving a brief account of the natural rarities, inhabitants and diseases of the Country.*** Translated into English from the Dutch. London, Lintott [1709].

Fund for Rare Books.

Velez de Arciniega, Francisco. Historia de los animales mas recebidos en el vso de medicina; donde se trata para lo que cada vno entero, ô parte del aprouecha, y de la manera de su preparacion.*** Madrid, Imp. Real, 1613.

Fund for Rare Books.

Manuscripts

Paul, J. Rodman, and McClenahan, Wm. U. A Pathological Study of the Pleural and Pulmonary Lesions in Rheumatic Fever.
[*Typewritten.*]
[*Alvarenga Prize Essay, 1928.*]

Presented by the Alvarenga Prize Committee.

Shaffer, N. M. Clinical Lectures on Orthopedic Surgery Delivered at the University Medical College, 1882–83. Reported by LeRoy W. Hubbard.
[*Typewritten.*]

Presented by Mr. Graham Roberts.

Sinhalese (Ceylon) Ola or Book-manuscript, written about 1750 A.D. in Pali-Sinhalese on the prepared leaves of the Talipot palm. It is a copy of the famous work on Sinhalese medicine originally compiled several centuries before.*** The painted wooden covers and the ivory medallion, decorated with the sacred Bo tree symbols, are old but the binding cord is modern, after an early type by a native artist. The Yogaratnacara; see Annals of medical history, pt. 4, 1926, on Medieval medicine in Ceylon.

Presented by Casey A. Wood, M.D., through the courtesy of Burton Chance, M.D.

Other Interesting Additions

A photostat copy (negative and positive) of the First Medical College in Philadelphia from a water-color sketch made in 1864 by Charles A. Poulson, from Birch's view.

Presented by Mr. John Ashhurst.

A water-color sketch of Surgeon's Hall, South Fifth Street, Philadelphia. Painter, Thomas Wakeman, evidently a contemporary, possibly an Englishman. The picture was obtained from a dealer, Albert Berthel, Lands End, East Molesey, England.

Presented by Astley P. C. Ashhurst, M.D.

Testimonial of Members of the Medical Profession of Philadelphia in behalf of Wm. T. G. Morton, M.D., February 15, 1860.

Presented by W. B. Cadwalader, M.D.

A single wooden stethoscope made from one of the timbers of the old Edinburgh Infirmary.

Presented by Judson Daland, M.D.

An oil sketch of William Harvey.

Presented by Mr. E. F. Faber.

We have also received during the past year a number of interesting and more or less valuable autograph letters.

Use of the Photostat: During the past year there have been furnished to Fellows of the College 172 prints, and to other than Fellows, on application, 187 prints. These outside applications include requests from Boston; Concord, N. C.; Greenwich, Conn.; Hartford, Conn.; London, England; Madison, Wisconsin; New York City; Omaha, Nebraska; Philadelphia; Pittsburgh, Pa.; Toronto, Canada; Washington, D. C.; and Wilmington, Delaware.

The work for the Library has been continued as heretofore according to the instructions of the Library Committee. 3790 large and small prints have been made; 8 volumes of incunabula completed as well as various portraits and manuscripts.

Up to the present time there have been made photostat reproductions of 262 incunabula.

There has been some increase to the principal of the Library Endowment Funds through change in investment during the past year, as follows:

Henrietta Rush Fales Baker Fund	$126.56
Louis A. Duhring Library Fund	3,102.20
William F. Jenks Fund	26.56
E. E. Montgomery Fund	57.50
J. William White Fund	125.00
George B. Wood Fund	76.56
	$3,513.82

A complete list of all the Funds and the expenditures for the year is given in a previous part of this report. All additional expenses, salaries, binding, etc., have to be governed according to the funds appropriated by the College to the Library Committee annually.

There was an exhibition of works on Fractures, March 6, 1928, and an Exhibition of Harveiana in commemoration of the Tercentenary of the publication of William Harvey's work, *De Motu Cordis*, March 22–23, 1928.

An account of stock has been taken and any displacements found arranged in their proper order; no report has been made of any books missing from the shelves.

Library Committee,
George W. Norris, M.D.,
Chairman.

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